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ENVIRONMENTAL ASSESSMENT OF BLM LEASING PROGRAM



MILES CITY DISTRICT

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

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INTRODUCTION

Chapter 1, Proposed Action, of this assessment pertains to oil and gas activities in the states of Montana, North Dakota, and South Dakota. It provides an overview of oil and gas operations and of the general oil and gas situation in this three state area. The remainder of this assessment, Chapters 2 through 5, focuses upon specific environmental considerations concerning oil and gas activities within the Miles City District.

PURPOSE & NEED

This Oil and Gas Environmental Assessment has been prepared pursuant to Section 102(2)(c) of the National Environmental Policy Act of 1969, as amended. It is designed to assess the impacts from federal oil and gas leasing by the Montana State Office of the Bureau of Land Management (BLM), United States Department of the Interior, in the states of Montana, North Dakota, and South Dakota.

CHAPTER 1

CHAPTER 1

The Proposed Action is the continuation of BLM's oil and gas leasing program in Montana and the Dakotas in order to make federally administered oil and gas resources available to the region and nation.

This assessment, an integral part of BLM's leasing program, is designed to provide the foundation and framework for the utilization of environmental considerations required in the course of issuing oil and gas leases in the three-state area by the BLM. It identifies environmental factors requiring protection and attaches appropriate stipulations on oil and gas activity to insure that protective measures are implemented.

The objectives of the BLM oil and gas leasing program are: (a) continuation of federal oil and gas leasing with appropriate environmental protection in areas where oil and gas development is environmentally acceptable; and (b) identification of areas which, regardless of the stipulations, are not suitable to oil and gas leasing due to environmental considerations.

The analysis required to meet these objectives will allow BLM to stratify leasing decisions according to environmental sensitivity. This stratification provides a basis for continued leasing associated with meeting the objectives of the National Environmental Policy Act of 1969 as amended and BLM's Federal Land Policy and Management Act of 1976. In practice, a lease application for a given area will be reviewed concerning (1) the impact causing actions discussed in this chapter and (2) the area's sensitivity to these impact causing actions. These considerations will be the basis for a decision to either lease the area with appropriate stipulations which would effectively protect the resource(s) or not to lease because of extremely sensitive features in the area which cannot be protected with the existing range of stipulations.

Scope

The proposed action includes all practices by the BLM and the U.S. Geological Survey (GS) in issuing and administering oil and gas leases over the approximately 50 million subsurface acres under the management of the BLM in the three-state area.

Although the BLM is responsible for the leasing of federal oil and gas under Forest Service surface, this assessment will not attempt to study environmental impacts on those lands. Instead, the BLM will refer to site-specific environmental assessment and recommendations made by the Forest Service concerning oil and gas development on land it administers. It should be noted that the BLM and Forest Service coordinate closely in these matters based upon a 1978 cooperative agreement between the two agencies. This agreement encourages coordination in order to make both agencies aware of respective roles and responsibilities concerning environmental assessment. It also insures that the analytical approach and data bases used by both agencies are compatible and will facilitate reviews and recommendations between the two agencies.

In addition to its subsurface jurisdiction, the BLM currently administers approximately 8.4 million surface acres in the three-state area. The surface and subsurface acreage administered by the BLM in each state are shown in Figure 1-1.

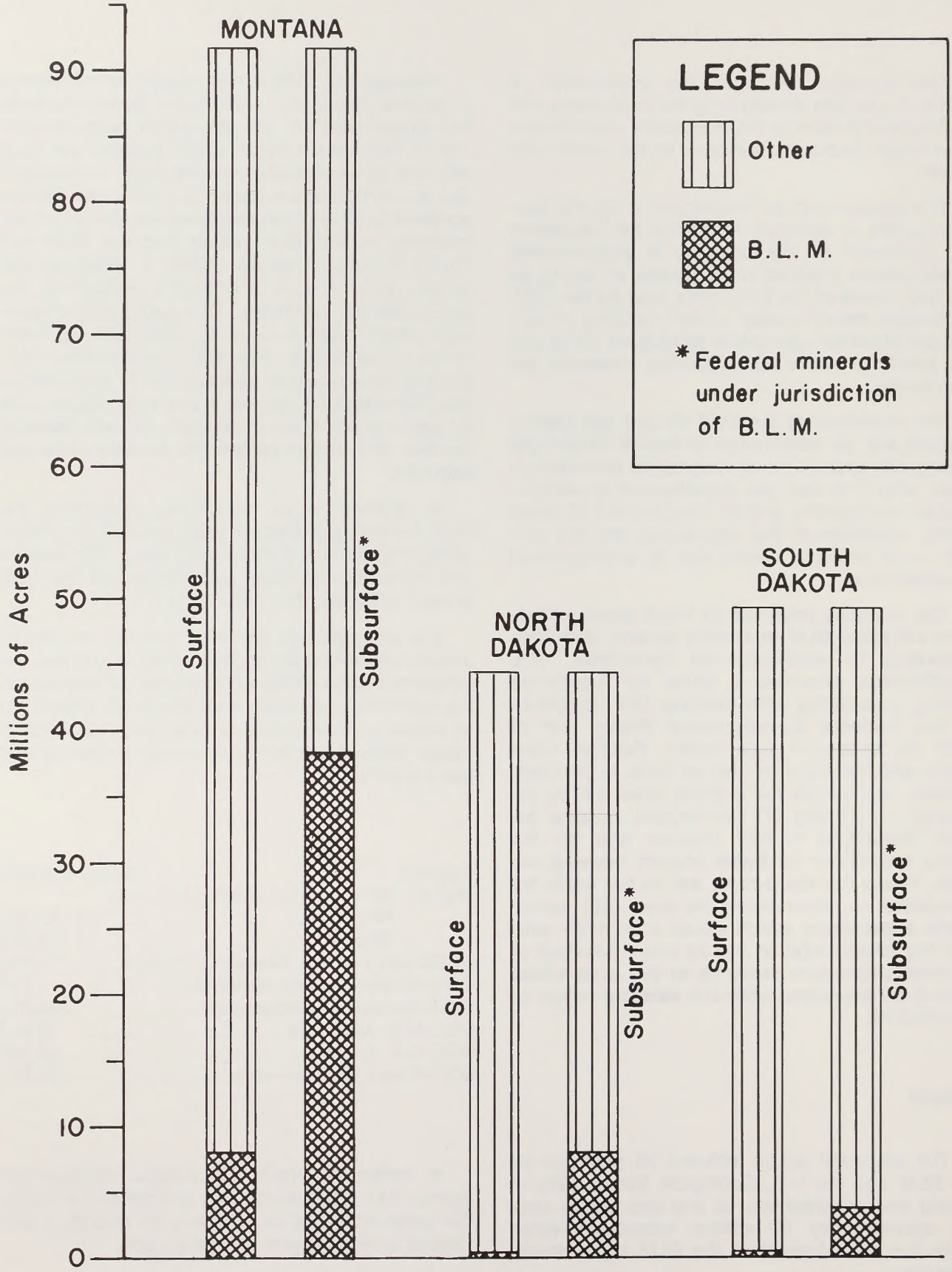
It is expected that this document can be used to assess environmental impacts from oil and gas development upon lands administered by the following agencies with surface management jurisdiction in Montana, North Dakota, and South Dakota in cases where these acreages overlie federal oil and gas subsurface:

Agency	Surface Acres
USDA - National Forest System Lands	
Region 1	18,102,368
Region 2	1,766,372
USDA-Agricultural Research Service	71,700
General Services Administration	714
USDI-Bureau of Reclamation	284,018
DOD-U.S. Air Force	8,916
DOD-U.S. Army	18,136
DOD-Corps of Engineers	607,678

In instances where the surface management agency has prepared its own site-specific analysis, this assessment will be available for reference with respect to likely environmental impacts.

FIGURE 1—1

SURFACE AND SUBSURFACE ACREAGE



Source: B.L.M. IN MONTANA, U.S.D.I., 1977 & Geologist, Branch of Lands & Minerals, M.S.O.

1.1 ENERGY BACKGROUND

The United States has experienced significant changes in its political and economic well being as a result of its dependence upon inexpensive foreign supplies of energy. The Arab oil embargo of 1973 precipitated an energy "crisis" in the sense that cheap, seemingly unlimited supplies of petroleum were no longer available to the U.S. The subsequent quadrupling of crude oil prices in the period of a few months made this nation and other industrial powers aware of their dependency upon nations which hold large reserves of petroleum. Domestic oil and gas development, in conjunction with energy conservation, was encouraged in the U.S. and elsewhere with the aim of reducing dependency upon foreign energy supplies. This effort has become increasingly more important in light of recent oil price increases ($20.71 per barrel) from foreign sources and because the U.S. is currently importing approximately 50% of the oil it uses.

The United States, the world's leading energy consumer, has historically been highly dependent upon both natural gas and petroleum as energy sources. In 1975, natural gas and petroleum together comprised approximately 74% of the nation's energy diet (petroleum 45%, natural gas 29%). This is a significant increase over the 47% contribution of these two fuels in 1947. Although overall energy consumption in the U.S. grew at an average annual rate of 2.8% between the years 1947 and 1975, the continued growth in petroleum and natural gas consumption averaged 8.4% per year, or approximately three times the annual growth rate of total national energy consumption. Figure 1-2 shows the increase in total energy consumption from 1947 to 1975 and the growing role of petroleum and natural gas in satisfying this demand.

It is obvious that national energy consumption would grow during this period as the nation became more populated. However, per capita energy consumption in the U.S. increased by 46% from 1947 to 1975. This means that, on the average, every individual in the U.S. in 1975 consumed approximately one and one-half times as much energy per day as in 1947. The increased growth in petroleum consumption in the United States has been made possible, to a great extent, by importing oil, and more recently liquefied petroleum gas, from other countries. Energy forecasts indicate that national consumption will continue to outstrip domestic production at least through the year 1990 (Figure 1-3).

Many areas of the world have supplied the United States' petroleum consumption during the last decade. In 1979 the U.S. was relying upon the Organization of Petroleum Exporting Countries (OPEC) for 72% of its annual oil imports (Figure 1-4). Forecasts of liquid hydrocarbon and natural gas supply through the year 2000 indicate a growth in imports of both fuels in order to keep pace with national consumption (Figures 1-5 and 1-6).

There exist many opportunities for energy conservation without a reduction in living standards in a nation which, with 6% of the world's population, accounts for approximately 34% of the earth's annual energy consumption. This rate of energy consumption is far greater than in many other modern societies with similar standards of living.

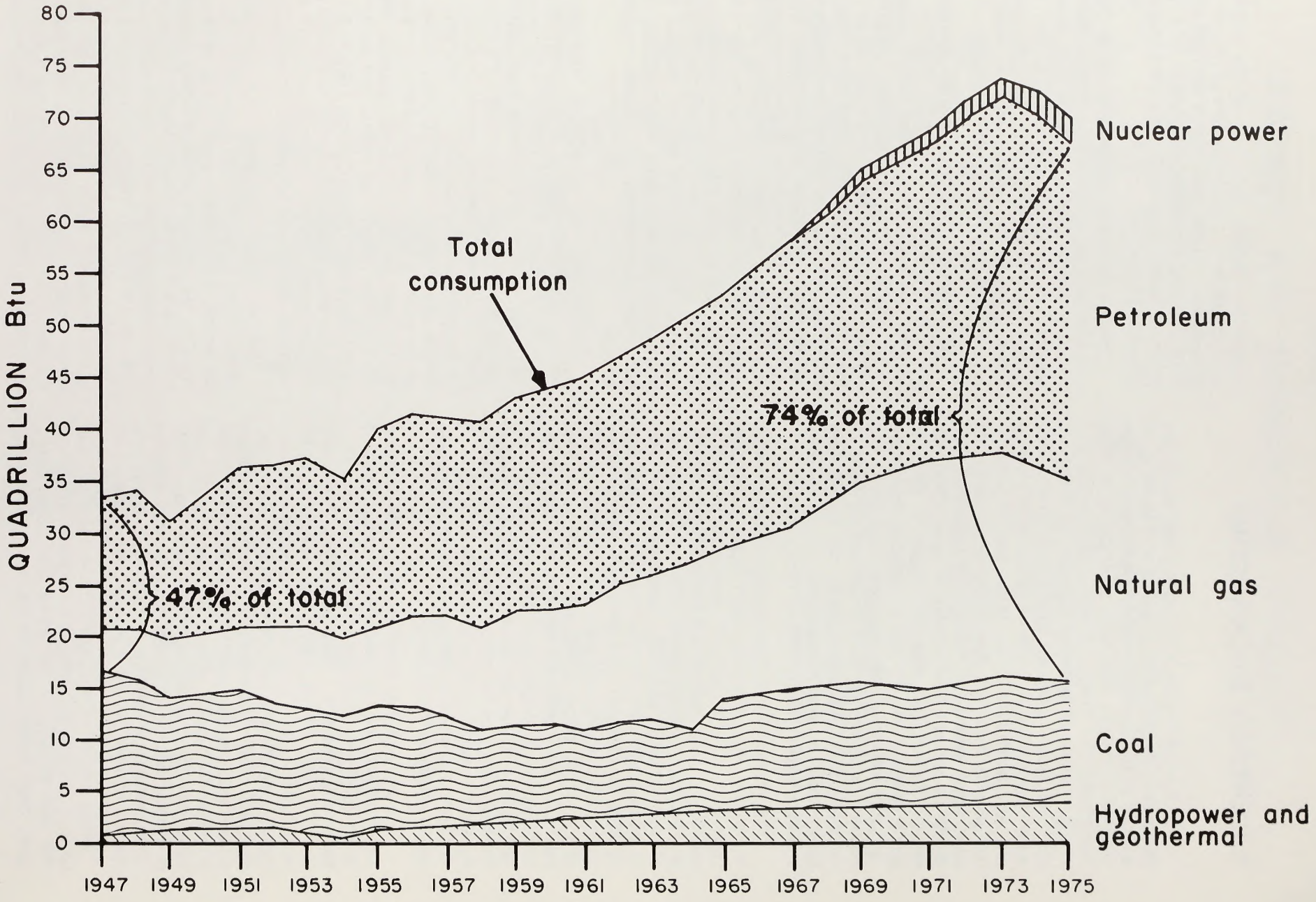
As a part of a national program sponsored by the U.S. Department of Energy, Montana, North Dakota, and South Dakota have begun implementation of state energy conservation programs designed to reduce energy consumption by 5% to 6% from projected levels by the year 1985. These state programs embrace many aspects of energy conservation such as home weatherization, industrial, commercial, and residential lighting standards, thermal efficiency standards, carpooling, and energy conservation education, to mention a few. It is likely that these programs will receive increasing attention as it becomes more apparent that energy conservation is an effective way to improve the nation's economic well-being while reducing our unnecessary dependence on foreign supplies of energy.

The oil and gas industry in Montana, North Dakota, and South Dakota is significant nationally. In 1976, Montana ranked 13th in crude oil production, with 1.1% of the nation's total, and 17th in natural gas production, producing 0.2% of the total. North and South Dakota ranked 17th and 30th, respectively, in oil production, and 19th and 50th in natural gas production. North Dakota supplied 0.9% of the nation's total crude oil production, and 0.1% of the gas production. South Dakota produced .01% of the nation's oil output, and currently has negligible natural gas production. Oil and gas activity in the study area is influenced by national trends; consequently, activity has increased with the nation's growing need for petroleum products.

Drilling activity fluctuates, but has generally been on the increase in the three-state area. As of December 1977, there were 3,330 producing oil wells in Montana, 69 wells in South Dakota, and 2,200 wells in North Dakota. Figure 1-7 shows total annual drilling activity in the three-state area from 1966 to 1977. Even though drilling activity has not changed significantly between 1966 and 1977, the actual annual production of oil and gas in Montana, North Dakota, and South Dakota decreased during the period 1967 to 1976 (Figure 1-8). Oil production decreased by 9% and gas production decreased by

FIGURE 1–2

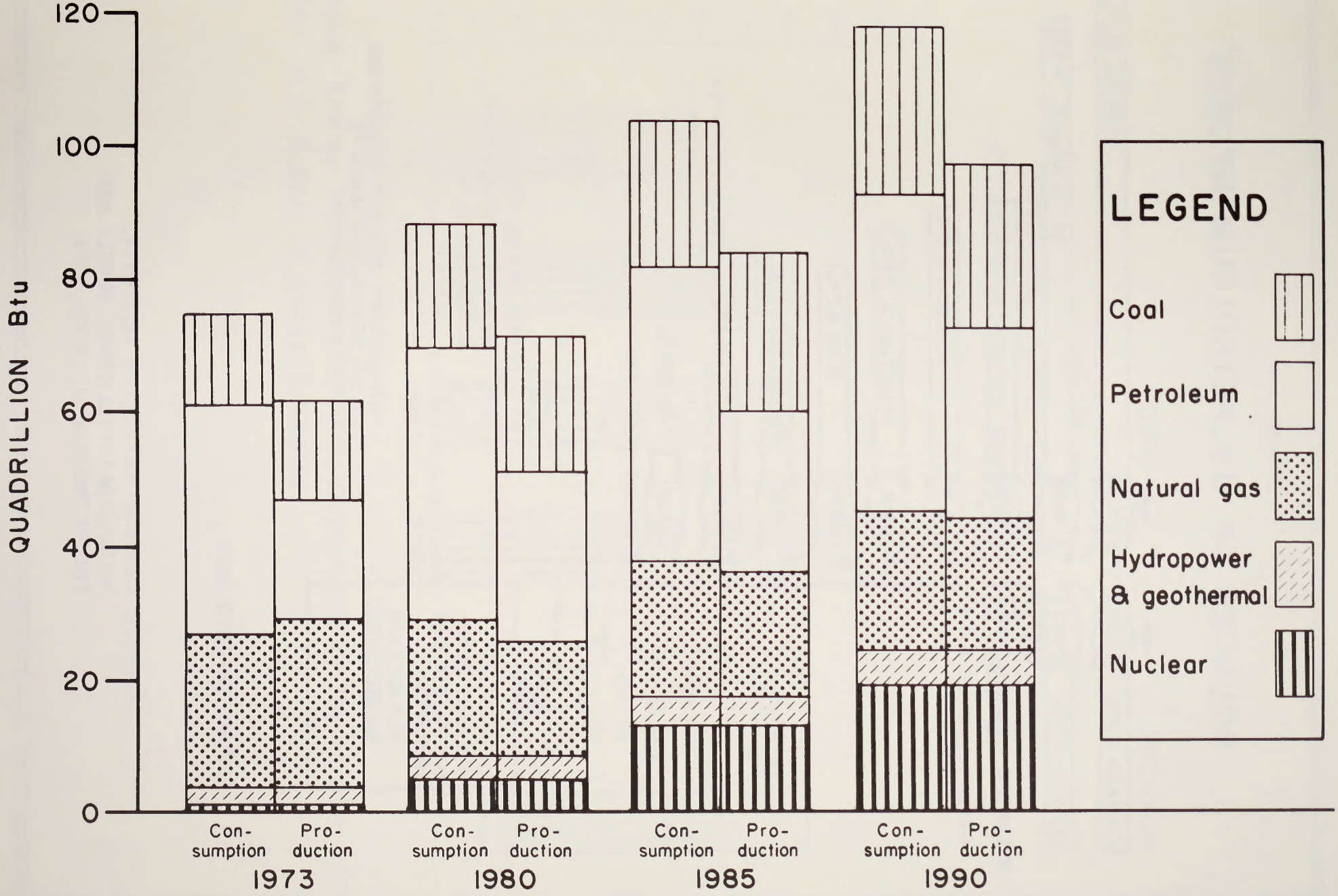
TOTAL U.S. ENERGY CONSUMPTION



Source: Energy Perspectives 2, U.S. Department of the Interior, 1976.

FIGURE 1-3

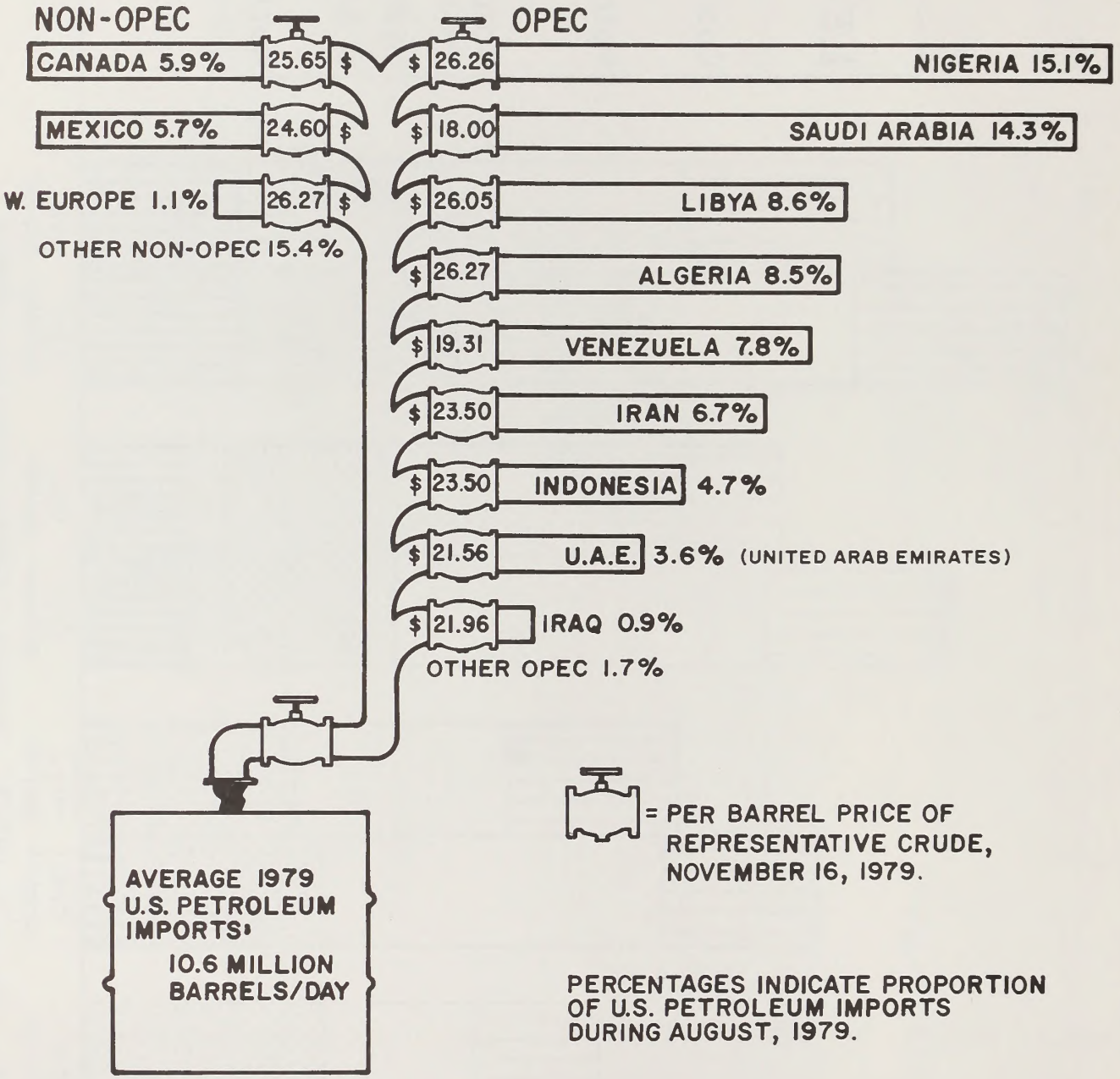
U.S. ENERGY PROJECTIONS, 1973-90



Source: Energy Perspectives 2, U.S. Department of the Interior, 1976.

FIGURE 1-4

SOURCES OF U.S. PETROLEUM IMPORTS*

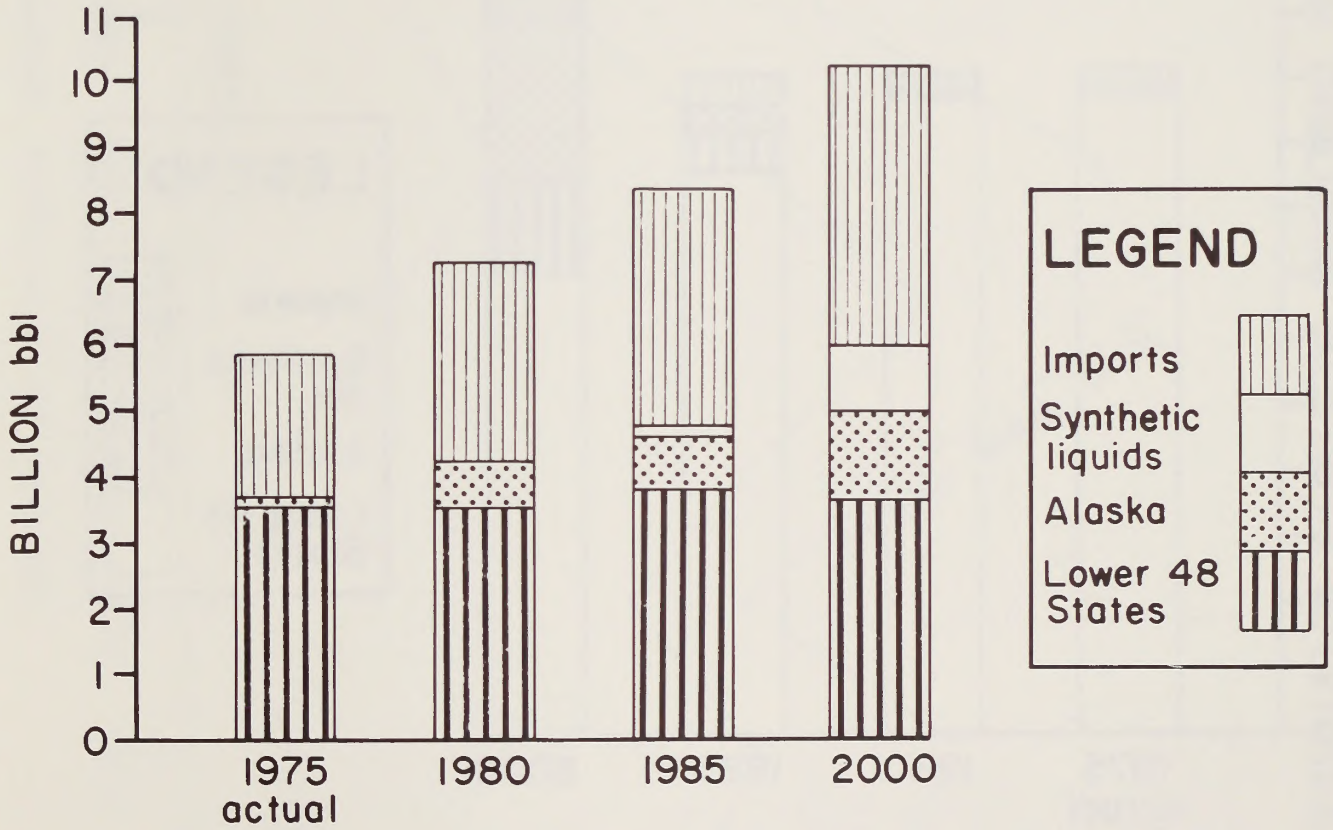


*DIRECT IMPORTS ONLY

SOURCES: AMERICAN PETROLEUM INSTITUTE, PETROLEUM INTELLIGENCE WEEKLY AND THE PETROLEUM SITUATION, 1979.

FIGURE 1–5

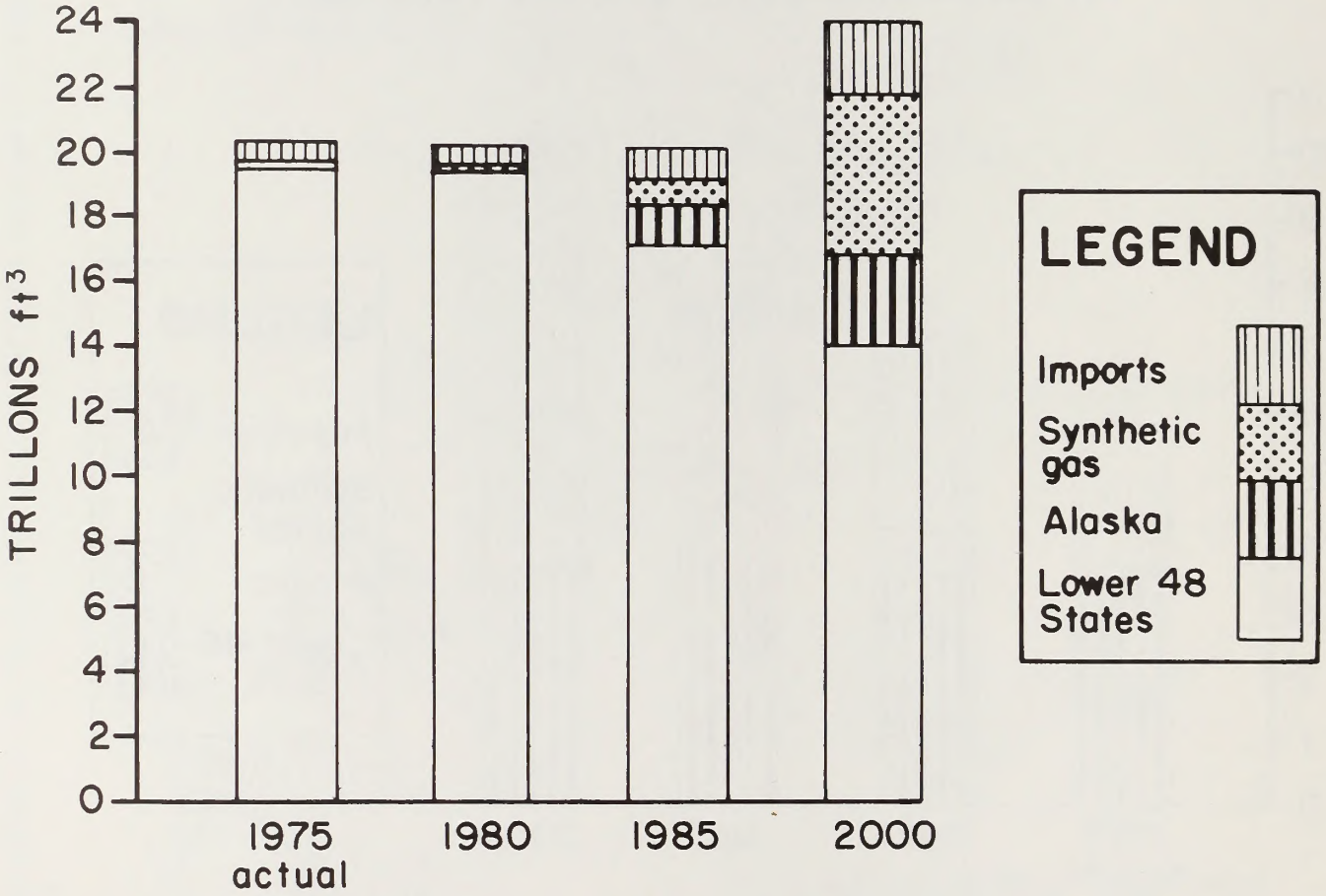
PROJECTIONS OF U.S. LIQUID HYDROCARBON SUPPLY, 1975-2000



Source: Energy Perspectives 2, U.S. Department of the Interior, 1976.
Note: U.S. Bureau of Mines estimates.

FIGURE 1–6

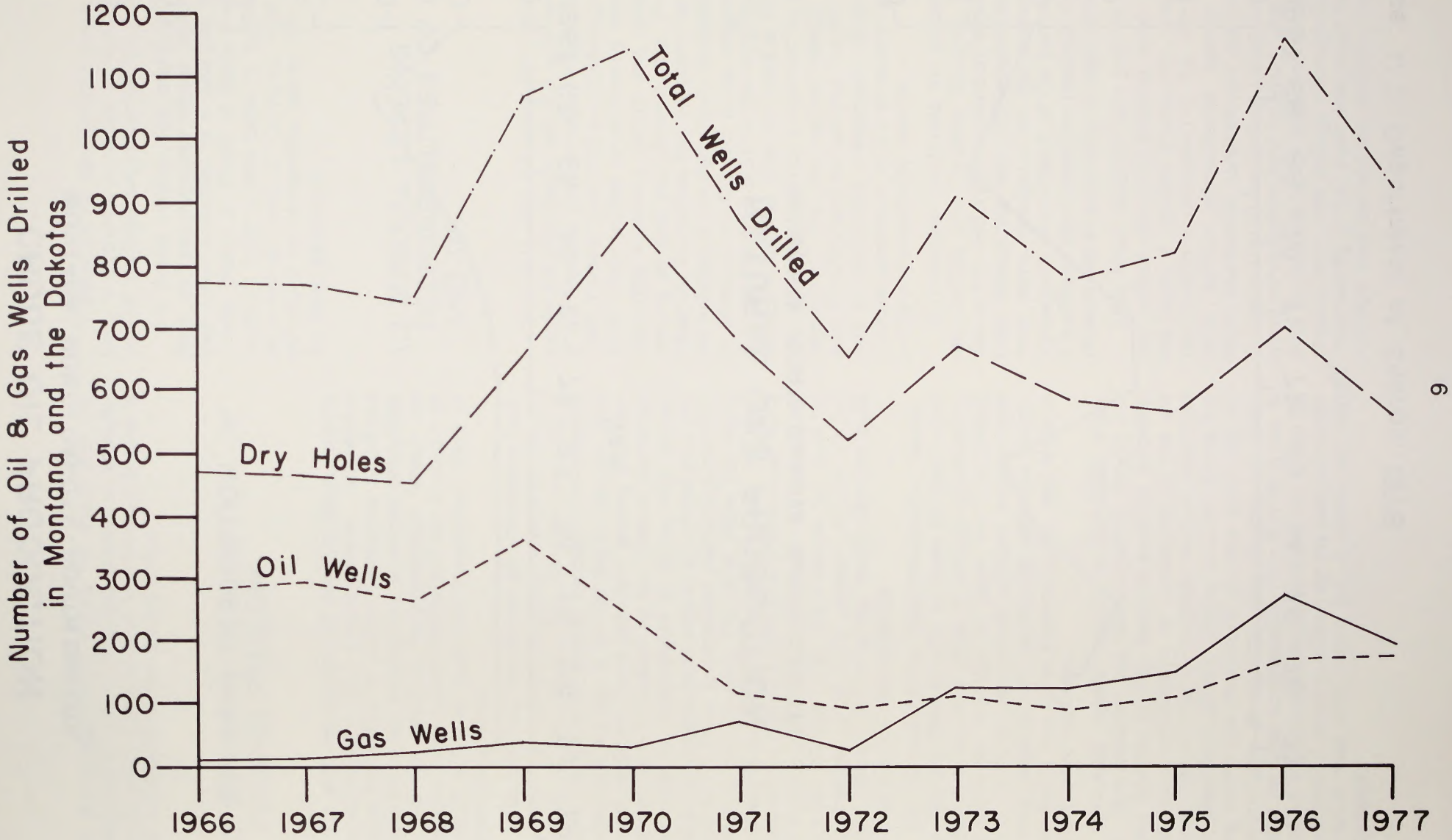
PROJECTIONS OF U.S. GAS SUPPLY, 1975-2000



Source: Energy Perspectives 2, U. S. Department of the Interior, 1976.
Note: U.S. Bureau of Mines estimates.

FIGURE 1–7

TOTAL WELL DRILLING ACTIVITY IN THREE STATE AREA

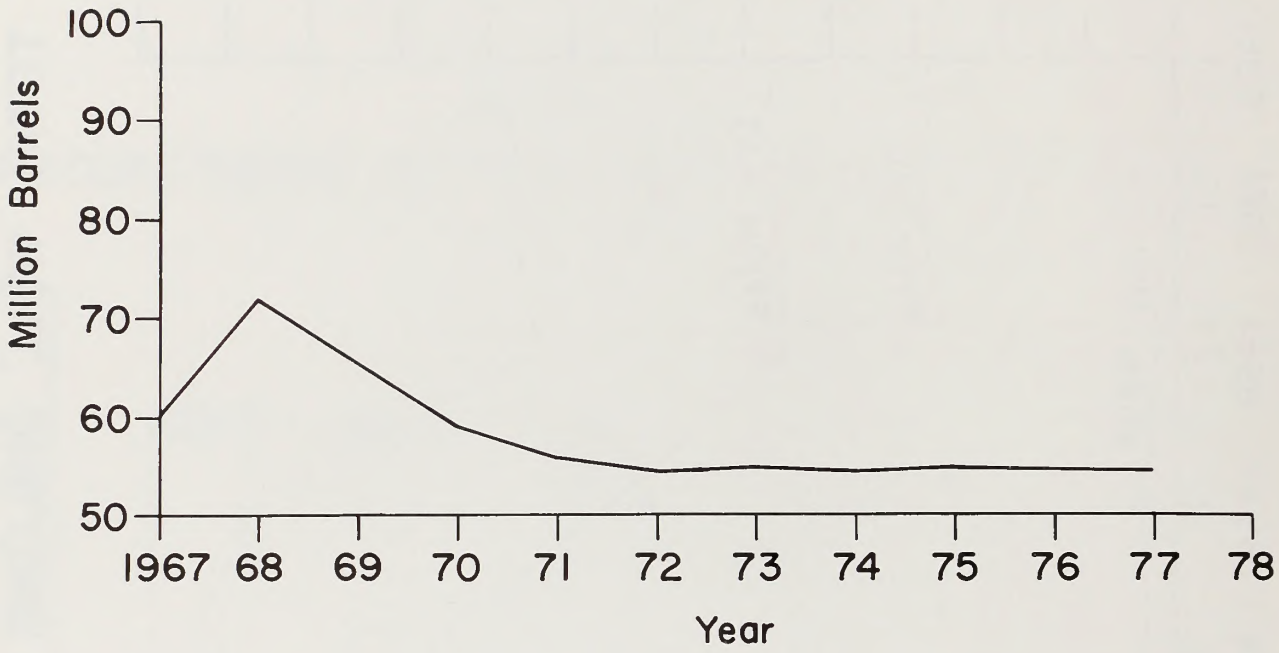


Source: Independent Petroleum Association of America.

FIGURE 1—8

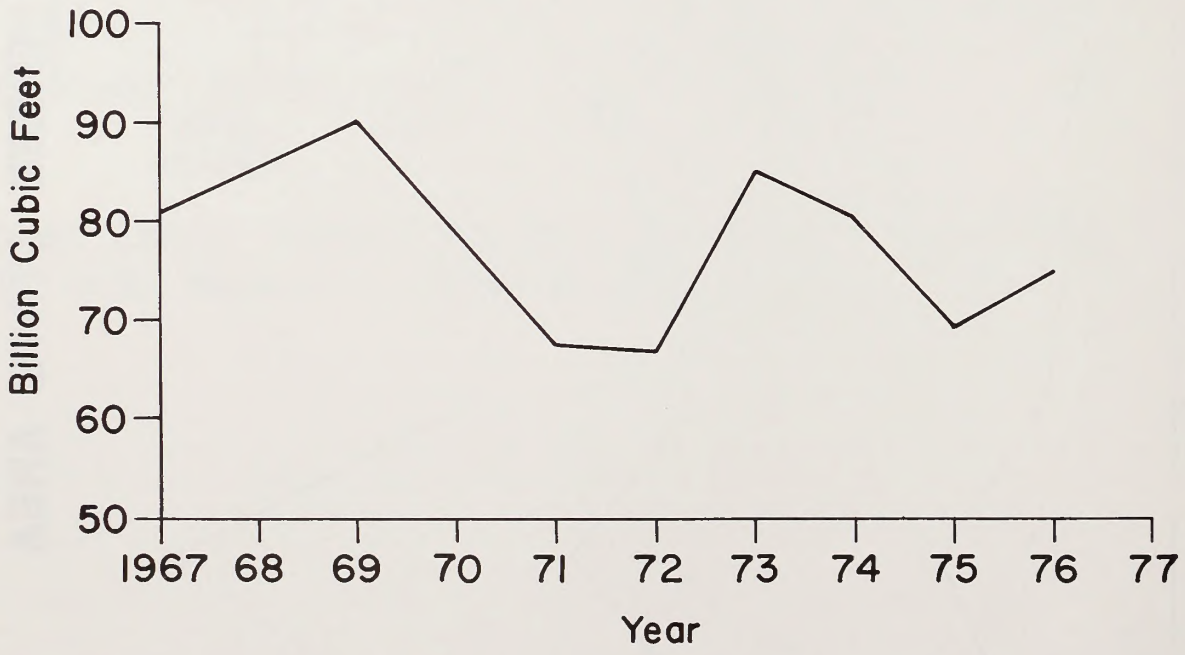
CRUDE OIL PRODUCTION

MONTANA - NORTH DAKOTA - SOUTH DAKOTA



NATURAL GAS PRODUCTION

MONTANA - NORTH DAKOTA - SOUTH DAKOTA



Source: U.S. Department of Energy, 1978

8% during this period. Figure 1-9 shows that the proportion of total oil and gas production attributable to public subsurface in the three-state area is two to three times that for the nation.

1.2 SUMMARY DESCRIPTION OF LEASING PROCESS

Oil and gas leases fall into two basic categories--competitive and noncompetitive. Competitive leases are issued in Known Geological Structures (KGS) which are areas known to contain producible oil and gas deposits. Noncompetitive leases are issued for land outside KGSs and are available as a result either of open over-the-counter offers or simultaneous filings.

KGS land may be offered for competitive leasing based on response to public request on Bureau initiative. If this occurs, the GS then prepares a report as to KGS status, recommends whether competitive leasing is in the public interest, and groups tracts into lease parcels. If leasing is recommended, land nominated by the public is combined with other GS nominations (in active KGS areas), and a competitive lease sale is scheduled after the BLM district office is consulted concerning conflicts with land use planning. The BLM offers the tracts for lease through competitive sealed bids. The adequacy of the high bids tendered is determined by a bid evaluation team composed of representatives from the GS and BLM. Each sealed bid must be accompanied by an initial payment of 20% of the bonus offered; the remaining bonus payment must be paid prior to lease issuance.

On noncompetitive (over-the-counter) leases, the applicant files an offer to lease on lands open to lease in non-KGS areas. If, through adjudication, the lands are available for lease, the BLM district office or other appropriate surface management agency responds with appropriate land use recommendations and, upon approval, a ten year lease is issued to the applicant.

Previously leased parcels in non-KGS areas (i.e., simultaneous and noncompetitive filings) are listed monthly as they become available following expiration, cancellation, or termination of the old leases. Once a list of available tracts is approved and advertised, all applications received during the filing period are considered to have been filed simultaneously. An applicant may file only one application per tract accompanied by a $10 filing fee. A drawing is held and three applications are drawn for each tract. A lease is offered on the parcel in order in which they were drawn (i.e., a winner and two alternates).

If there are no simultaneous lease offers for a tract, it becomes available to the first over-the-counter applicant subsequent to the drawing.

All leases require rent payment in advance. Rent on noncompetitive leases is $1 an acre a year. Upon production of oil and gas, the minimum royalty charge is 12.5% of value. Prior to drilling, applicant must secure bond to insurance compliance with all terms of the lease. Rent and royalty schedules on competitive leases are described in the lease agreement.

1.3 MINERAL LEASING RESPONSIBILITIES OF BLM AND GS

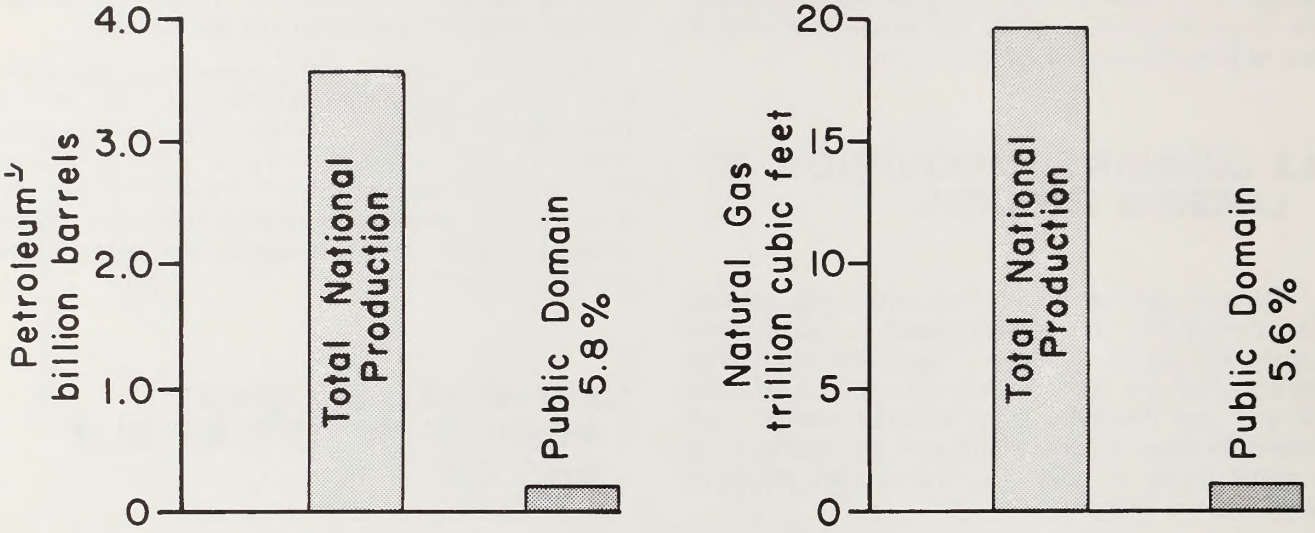
The BLM and GS have joint responsibility to assure full compliance with the spirit and objectives of the National Environmental Policy Act (NEPA) of 1969, Federal Land Policy and Management Act of 1976, other federal environmental legislation, and supporting Executive Orders and regulations concerning oil and gas development. Prior to lease issuance, the Bureau has the prime responsibility in the exercise of the Secretary's discretionary authority whereas the GS has prime responsibility, with concurrence from BLM relative to protection of the surface resources, after the lease is issued. Generally, GS's responsibility is confined to the "area of operations." This area can be defined as that surface including and surrounding the drill pad necessary for the drilling, subsequent development, and possible production of the oil and/or gas well(s) in a safe and reasonable manner.

As previously mentioned, the Bureau has prime responsibility prior to lease issuance. In the exercise of this responsibility, standard stipulations have been formulated, with GS cooperation, to cover most items necessary for the protection of and subsequent rehabilitation of the surface resources. If additional stipulations are required, these are formulated and included prior to lease issuance.

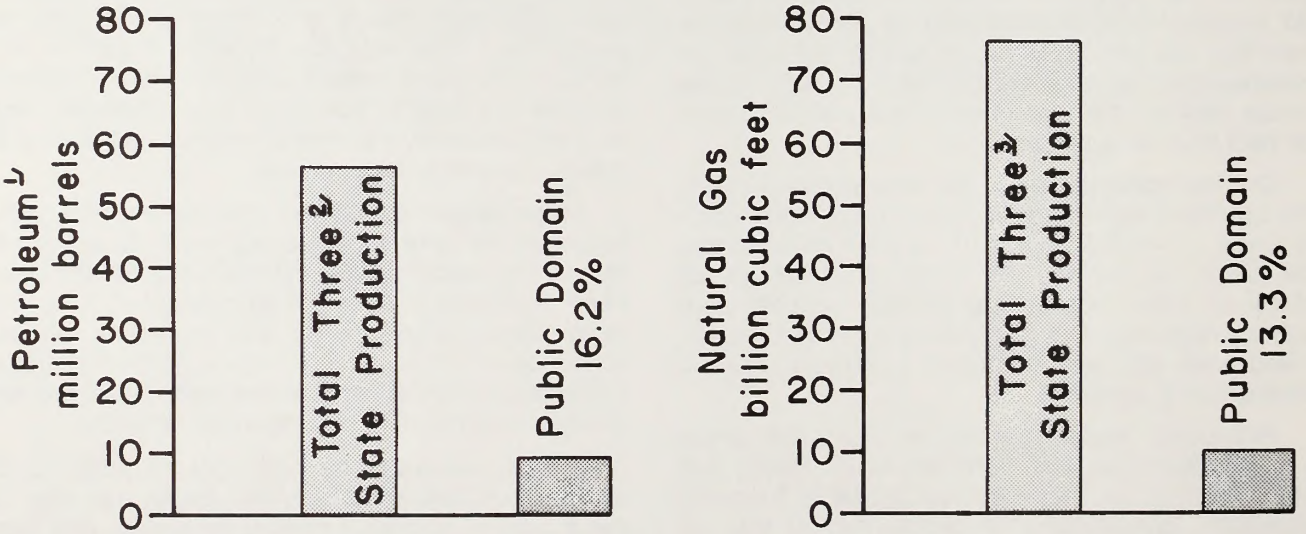
After lease issuance and prior to approval of any surface disturbing activities within the area of the lease, a detailed site-specific review and field examination is conducted by the GS and BLM or other surface administering agency. From this effort, site-specific requirements are formulated for the protection of the surface resources and subsequent rehabilitation, and imposed upon the lessee prior to approval of the proposed activity (i.e., geophysical work, well drilling). Although GS has prime responsibility at this point, they must have full concurrence from the surface managing agency. If dif-

FIGURE 1–9

U.S. FOSSIL FUEL PRODUCTION—1976



MONTANA, NORTH DAKOTA, SOUTH DAKOTA FOSSIL FUEL PRODUCTION—1976



Source: M.S.O. Geologist, Branch of Lands & Minerals.

[1] Includes crude oil & the heavier natural gas liquids.

[2] Represents approx. 1.6% of total national production.

[3] Represents approx. 0.4% of total national production.

ferences exist, these are forwarded through various administrative levels and eventually to the Secretary.

1.4 FEDERAL, STATE, AND LOCAL ACTIONS

In order to better understand oil and gas leasing operations, the following discussion describes the responsibilities of the various governmental bodies in each phase of the operation.

Federal Actions

Exploration

There is no statutory authority for oil and gas exploration. Subpart 3045 of the Code of Federal Regulations (1970) established procedures to be followed in such operations.

Before geophysical operators conduct any operations on public lands, they are required to file a "Notice of Intent" with the District Manager, BLM.

The geophysical operator has a responsibility to cooperate and coordinate his operation with the District Manager. The operator's responsibilities are to:

- File a Notice of Intent on unleased lands, with maps showing proposed seismic lines and all necessary access routes before operations begin. The map should be a minimum scale of 1/2 inch to the mile.
- Be bonded.
- Notify the District Manager before he enters onto public lands.
- Obtain the District Manager's written approval for bulldozer or other dirt work.
- Notify the District Manager in writing of any changes in the original notice and secure written approval before proceeding.
- Comply with stipulations imposed by the District Manager at the pre-work conference and during field investigations.
- File a Notice of Completion.

The District Manager's responsibilities are to:

- Examine resource values and develop appropriate surface protection and reclamation measures.
- Conduct compliance inspections.
- Coordinate with the geophysical operator to explain the terms of the Notice of Intent, including operating practices to be followed or avoided, all relevant laws, and BLM administrative requirements.
- Complete final inspection after the Notice of Completion is filed. The inspection must determine that all instructions were complied with and all rehabilitation practices completed. A 90-day limit for the final inspection and notification of additional work is established by regulation. If further instructions are given to the operator at final inspection, an additional 90-day limit is established for the BLM after notification that the operator has completed his work.
- Release operator's bond.

A prospecting permit is required for geophysical work on Forest Service surface. This permitting process is similar to that used in BLM's Notice of Intent.

Operations

Once a federal lessee or designated operator indicates that he wishes to explore on or develop a lease, all proposed drilling operations and related surface disturbance activities must be approved before entry upon the lands involved. Approval will be in accordance with: (1) lease terms, including any additional lease stipulations; (2) Title 30 CFR Part 221, "Oil and Gas Operating Regulations," and (3) "Notice to Lessees No. 6" (NTL-6) issued by the GS effective June 1, 1976. The requirements that must be approved include the following:

Preliminary Review. A preliminary environmental review is required of all drilling proposals prior to entry on the ground to stake the location, access roads, and other surface-use areas. The operator must furnish a map of a scale not less than 1 inch equals 1 mile, that shows the preferred location and general topographic features, and explain the anticipated activity and surface disturbance to the District Engineer, GS, as well as the District Manager, BLM. This permits the district manager to identify any potential conflicts with other resource values. If conflicts are noted, a joint conference or field inspection is held involving USGS, BLM, and the operator.

Application for Permit to Drill. Prior to drilling or road construction on a federal lease, the operator must submit an Application for Permit to Drill (APD). The APD includes a Surface-Use and Operations Plan. Where private surface is involved, it should include a copy of the written agreement between the lessee or operator and the surface owner. A letter from the lessee or operator setting forth reha-

bilitation requirements agreed to with the surface owner is acceptable.

The APD provides operational and geologic information required by the GS. The Surface-Use and Operations Plan must allow assessment of the environmental effects expected from the proposed project. Bonding coverage must be obtained by the applicant before approval of the APD by GS.

GS sends this information to the BLM District Manager, who reviews the plan and recommends surface-protection stipulations for the approved permit. The BLM must decide at this time if it desires to obtain the well as a water well if oil or gas is not encountered in usable quantities.

Approval of Operations. Before repairing, deepening, or conditioning an existing well, a detailed written work plan must be submitted to GS.

In existing fields operators are required to submit, for GS approval, plans for new construction, reconstruction, or alteration of existing facilities, when additional surface disturbance will result.

Abandonment. Well abandonment requires prior approval by the GS and the BLM, which may require additional surface rehabilitation. These requirements are normally part of the approved abandonment plan. Abandonment will not be approved until surface rehabilitation work required by the drilling permit or abandonment notice is complete, and required vegetation is established to the satisfaction of the BLM District Manager.

Water Well Conversion. If the BLM decides to acquire the well as a water well, it must assume responsibility at the time of abandonment. The operator will plug the well at the bottom of the desired fresh-water zone and leave casing in place. The operator then will begin surface cleanup as required. The BLM must reimburse the operator for casing and labor to complete the well.

Other Requirements

The Environmental Protection Agency has issued regulations affecting all oil and gas lessees and operators (Title 40 CFR, Part 112). These regulations require owners or operators to prepare Spill Prevention Control and Countermeasure (SPCC) Plans. EPA does not make special inspections to see that operators have SPCC Plans. They may call for one from an operator if they desire; if an operator does not provide one, he is subject to a fine. After a hazardous material spill, EPA usually calls for the operator's SPCC Plan.

Oil and gas operators must also meet requirements of the Department of Transportation and the Interstate Commerce Commission.

Table 1-1 summarizes the seven basic procedural steps necessary in obtaining a Permit to Drill for oil and gas on federal leases.

State Actions

If a well is productive, the state requires notification and a monthly report. A completion or recompletion report is also required. The Oil and Gas Conservation Commission in Montana, the Industrial Commission of North Dakota, and the South Dakota Board of Natural Resources are primarily interested in production and conservation of the oil and gas. Surface protection requirements are a matter between the surface owner and the operator. The State Commissioner of Public Lands issues state leases and also holds operator's bonds. He releases such bonds whenever the surface owner or lessee is satisfied. Monetary settlement is acceptable to the state in lieu of rehabilitation. If a well is a dry hole, operators are required to follow state procedures for plugging.

The above mentioned agencies have final authority on any well location variances. They also must approve unitization agreements. In addition, the states control water and gas injection systems, and underground gas-storage projects. The GS works with them on this, although the state has final authority.

Oil and gas operators are regulated by the State Department of Environmental Quality. This Department issues burning permits, if needed, as well as production-water discharge permits.

Local Actions

County governments are involved with oil and gas operators with respect to zoning, rights-of-way, and access.

The petroleum industry is very active in the study area. The headquarters of the Petroleum Association of Montana, located in Billings, is the state chapter of the Rocky Mountain Oil and Gas Association (RMOGA), headquartered in Denver. The major producers in the area belong to this association.

TABLE 1-1

PROCEDURAL GUIDELINES FOR ACTIONS ASSOCIATED WITH OIL AND GAS DEVELOPMENT

	Operator Action	Dept. of Interior Action	Field Activities	Normal Time Period
STEP I	1. Develops preliminary map and submits to GS and Bureau of Land Management. 2. Identifies necessary off lease rights-of-way. 3. Attends joint field examination if requested by Interior.	1. Performs preliminary environmental review. 2. Reviews for other authorizations necessary. 3. Notifies operator if site conflicts with other resource values. Notifies operator if no archaeological survey is required. 4. Requests joint field examination if necessary.	1. Operator reviews on-the-ground site. 2. Joint field inspection, if necessary.	1. 15 days after receipt.
STEP II	1. Operator surveys well location and centerline of access roads. 2. Identifies necessary off lease rights-of-way. 3. Arranges for archaeological clearance work. 4. Develops Multi-point Surface Use & Operations Plan. Prepares Application for Permit to Drill. 5. Acquires private surface owner agreement if appropriate.		1. Survey and stake well site and other facilities, includes centerline staking of roads. 2. Archaeological survey performed.	1. Variable; contingent upon operator schedules.
STEP III	1. Operator files APD, Multi-point Surface Use & Operations Plan, Private Surface Owner Agreement, and archaeological clearance. 2. Applies for necessary rights-of-way to Bureau of Land Management. 3. Attends joint field examination if requested by GS.	1. Reviews APD and Surface Use & Operations Plan. 2. Reviews archaeological survey. 3. Requests joint field examination, if appropriate. 4. Requests revision of plan if unacceptable. 5. Prepares necessary environmental analysis for APD and other federal actions required. 6. Prepares conditions of approval to APD and Multi-point Surface Use & Operations Plan. 7. APD approved or rejected. 8. Appropriate rights-of-way issued.	1. Joint field examination performed.	1. 30 days.
STEP IV	1. Performs in accordance with approval plan. 2. Files necessary reports to Geological Survey.	1. Compliance inspections.	1. Operator stakes well site exterior dimensions. 2. Operator begins construction and/or drilling activities. 3. Interior conducts compliance inspections.	1. Variable.
STEP V	1. Operator files Notice of Completion if well is a producer, plus modification to the Multi-point Surface Use & Operations Plan. Operator may need to arrange for additional archaeological survey on areas affected by plan modifications. 2. Operator files Notice of Intent to Abandon if well is dry hole. This can also be for a producer that has gone dry.	1. Reviews on-the-ground conditions for compliance and rehabilitation needs. 2. Reviews modifications to the Multi-point Surface Use & Operations Plan. 3. Requests joint field examination, if appropriate. 4. Requests revision of plan if unacceptable. 5. Prepares necessary environmental analysis for the plan and reviews archaeological survey. 6. Prepares conditions of approval to modified plan. 7. Plan approved or rejected. 8. Additional requirements for rehabilitation of disturbed areas developed for conditions of Intent to Abandon.	1. Joint field examination if necessary. 2. Field work performed to develop well and necessary 3. Field work performed to abandon well if this is the action. 4. Rehabilitation work begins on disturbed areas.	1. Review of plan, 30 days. 2. Rehabilitation work, one year.
STEP VI	1. Operator files Sundry Reports on a Well. Subsequent Report of Abandonment states all work is completed and ready for inspection.	1. Performs compliance checks to see that all conditions are met. 2. Approves final abandonment.	1. All work completed and ready for inspection.	1. Vairable; one-two years for vegetation establishment.
STEP VII	1. Applies for release of the period of bond liability.	1. Performs final check, if necessary. 2. Approves release of the bond liability.	1. Possible field inspection by Bureau of Land Management.	1. 30 days.

SOURCE: Surface Operating Standards for Oil and Gas Exploration and Development, Second Edition 1978.

1.5 PHASES OF ONSHORE OIL AND GAS ACTIVITY

Normally, onshore oil and gas operations progress through five phases: (1) Preliminary exploration, (2) Exploratory drilling, (3) Development, (4) Production, and (5) Abandonment. Preliminary exploration can occur on leased or unleased lands. The remaining four phases occur on leased lands. Each phase has a potential for causing some type of disturbance to the environment. A brief description of the purpose for each phase and those actions within a phase that could cause some type of environmental disturbance follows.

Preliminary Exploration

A clue to the presence of oil and gas may be revealed by a search for geological structures within the rock that may contain underground oil and gas "traps". Figure 1-10 shows typical structures that may contain oil or natural gas traps.

Surface maps and aerial photos help the geologist identify geologic structures. Additional data can be gathered by the use of aircraft. Low altitude reconnaissance flights, frequently at elevations of 100 to 500 feet, help identify rock outcrops that can be studied later on the ground. Higher altitude flights above 3,000 feet are often made to conduct photographic, geophysical magnetometer, and other sensing surveys.

On-the-ground geologic mapping, gravitational and magnetic prospecting may follow if the previous work shows promise of oil and gas traps or reservoirs. Figure 1-11 shows how the gravity methods works. Small trucks and jeeps with crews of several people can be used at this stage of subsurface data gathering, and off-road travel is likely.

If the information gathered is still indicative of structures conducive for oil and gas reservoirs, seismic prospecting may follow. A seismic survey is a method of gathering subsurface geological information by recording impulses from an artificially generated shock wave. The common procedure used in reflection seismic surveys on land consists of creating a shock wave, and recording; as a function of time, the resultant seismic energy as it arrives at a group of vibration detectors (seismometers) arrayed on the ground surface. Portions of the seismic energy reach the seismometers by several different routes. One portion spreads over the ground as a surface wave. Another travels along a subsurface layer and is refracted to the surface. A third travels downward until it reaches an abrupt change in lithology of rock characteristics and is then reflected back to the surface (Figure 1-12).

Seismic methods are usually described by the various methods of generating the shock wave. Seismograph units mounted on trucks are used to detect shock waves in the earth generated by thumpers, vibrators, or explosives. Ground vibrations are made by thumpers by dropping a steel slab weighing about three tons to the ground several times in succession along a predetermined line. The weight is attached by chains to a crane on a special truck. A typical thumper unit is shown in Figure 1-13.

The vibrator method is widely used and is replacing the explosive method. Typically, four large trucks are used, each equipped with a vibrator mounted between the front and back wheels (Figure 1-14). The vibrator pads (about four feet square) are lowered to the ground and vibrators on all trucks are triggered electronically from the recorder truck. After the information is recorded, the trucks move forward a short distance and the process is repeated.

Explosives have been widely used in the past to generate the seismic impulse or shock wave. Traditionally, the explosive charge is detonated at the bottom of a drill hole of 200 feet or less. Recently, however, techniques of detonating the explosives on the surface have been developed that give good results in some areas.

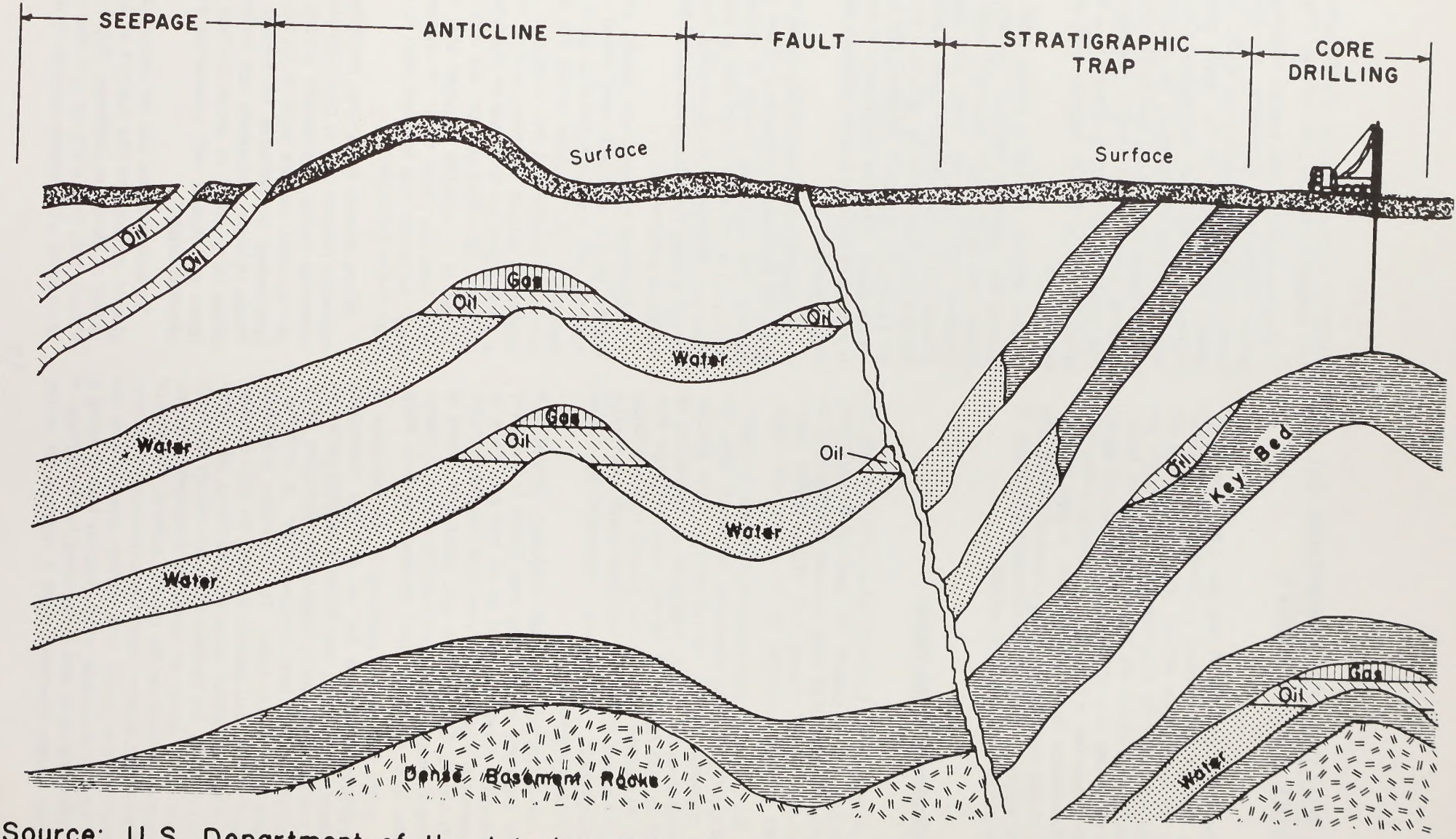
Subsurface charges are usually placed at the bottom of a 4 to 6 inch hole drilled with a truck-mounted drill. Access suitable to allow the drill and recording trucks to travel across the surface is required. Detonation of the charge in some areas causes no surface disturbance while in other areas a small crater (up to 6 feet in diameter) is created (Figure 1-15). Cuttings from the well are normally hauled to a suitable disposal site, scattered by hand near the "shot hole," or disposed of in the hole. Bentonite mud is often used to plug the surface of the shot hole.

Where access limitations, topography, or other restraints prevent use of truck mounted drill rigs or recording trucks, lightweight portable equipment can be used. Various kinds of portble drills can be backpacked or delivered by aircraft to the area. These portable operations use a pattern of holes drilled to a depth of about 25 feet. All of these holes are loaded with explosives and detonated simultaneously.

Surface charges can be placed directly on the ground surface, on the surface of snow, or on a variety of stakes or platforms. Paper cones, survey stakes, lath, or 2 x 4's up to 8 feet in length have been used with varying success in different areas.

FIGURE 1–10

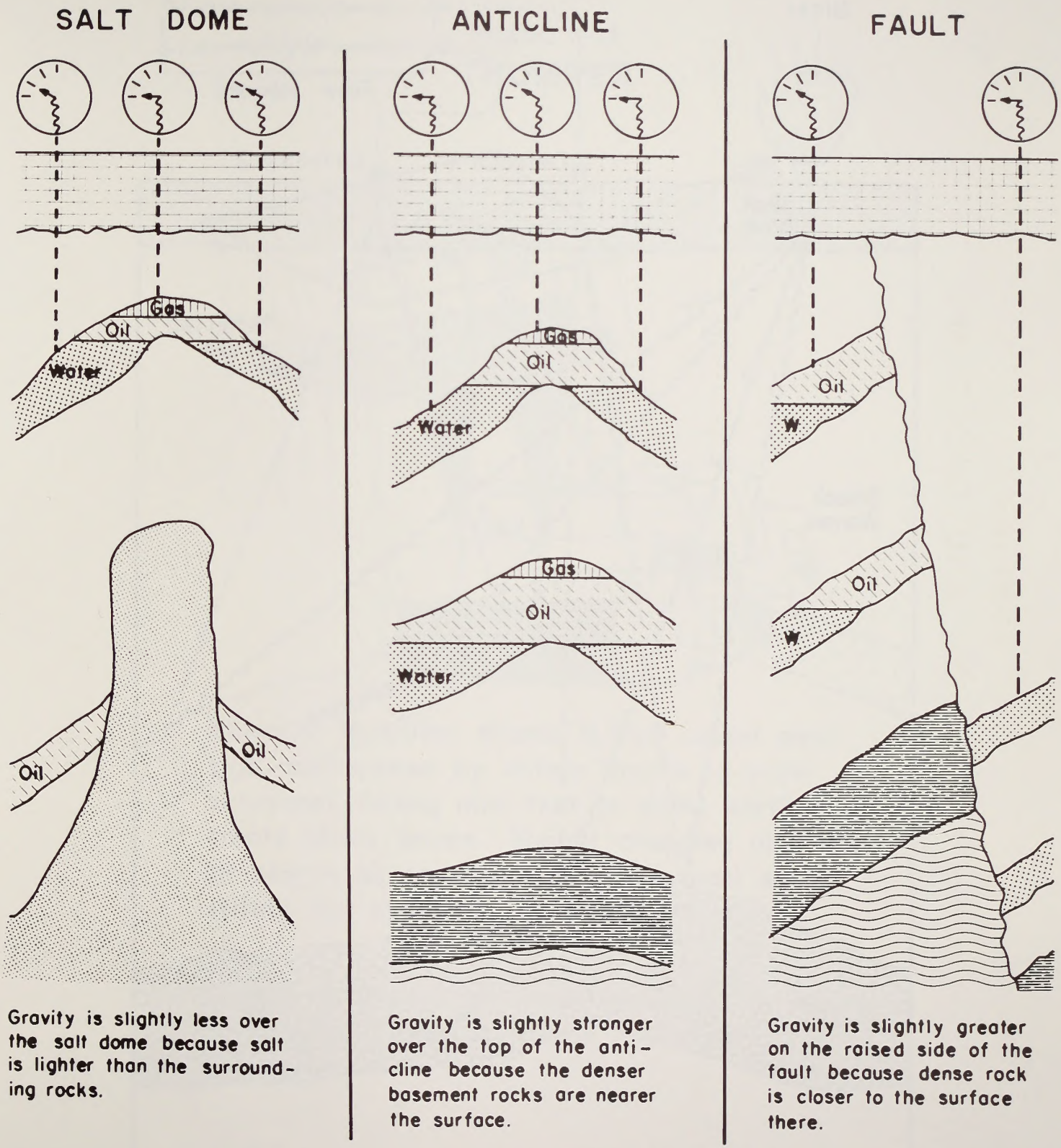
TYPICAL OIL AND GAS TRAPS



Source: U.S. Department of the Interior, Plain Facts about Oil, 1963.

FIGURE 1–11

GRAVIMETER



Gravity is slightly less over the salt dome because salt is lighter than the surrounding rocks.

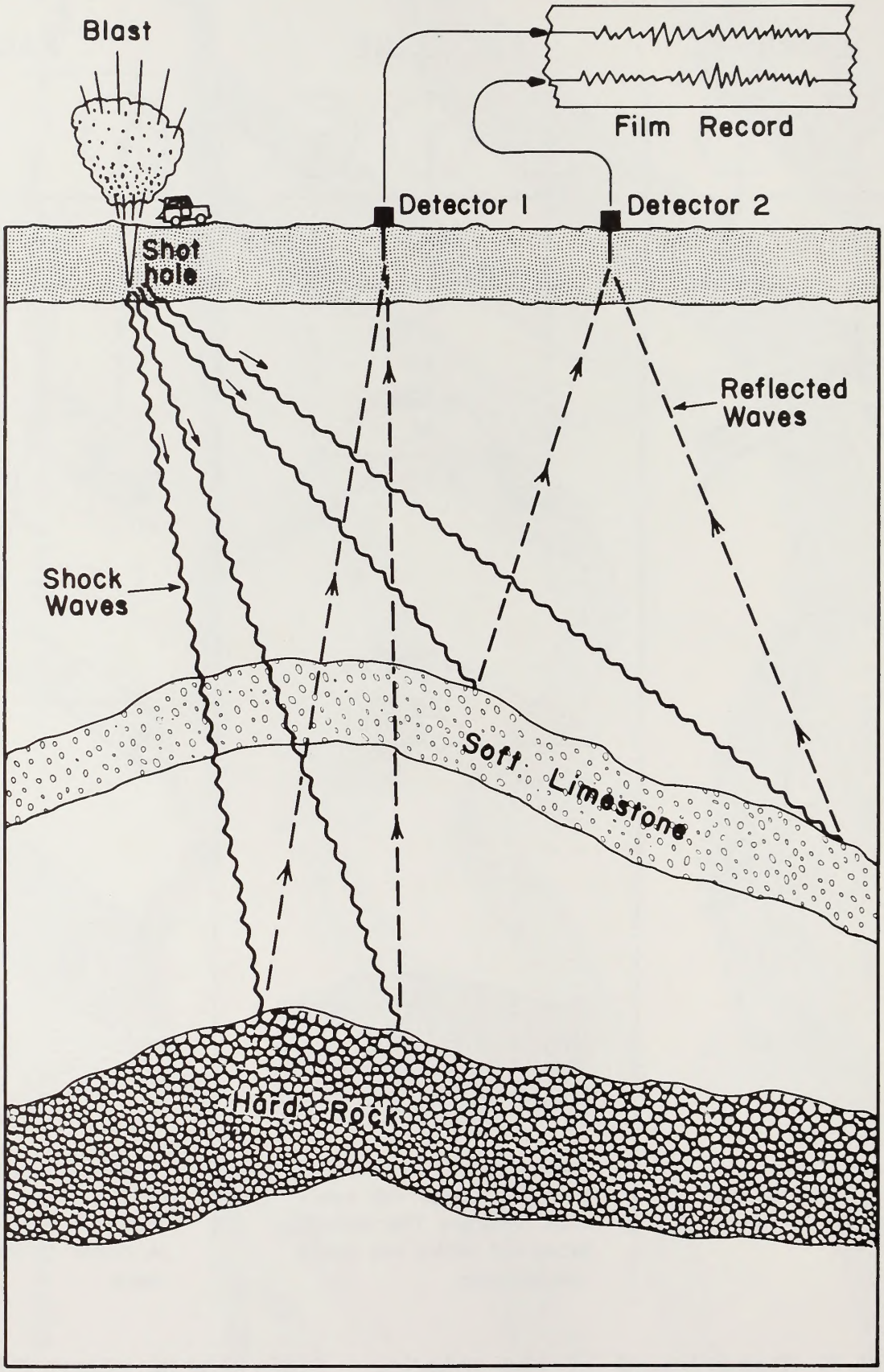
Gravity is slightly stronger over the top of the anticline because the denser basement rocks are nearer the surface.

Gravity is slightly greater on the raised side of the fault because dense rock is closer to the surface there.

Source: U. S. Department of the Interior, Plain Facts about Oil, 1963.

FIGURE 1–12

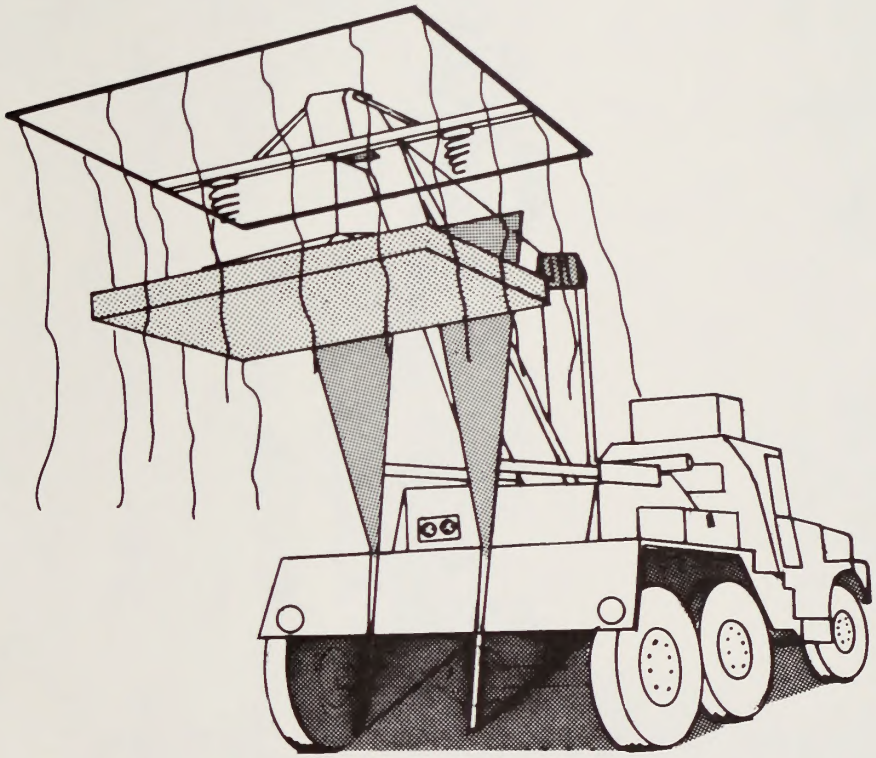
SEISMOGRAPH



Source: U.S. Department of the Interior, Plain Facts about Oil, 1963.

FIGURE 1–13

THUMPER



Thumper in action shows 6,000 pound steel slab, surrounded by safety chains to warn personnel, falling nine feet to strike earth and create shock waves. Weight-dropping aids the oil search as an effective economical substitute for dynamite in seismic operations.

Source: A Primer of Oilwell Drilling, University of Texas at Austin, 1976.



Figure 1-14
Vibrator Trucks During Seismic Operation
SOURCE: BLM



Figure 1-15
Shot Hole During Seismic Operation
SOURCE: BLM

Use of tall stakes or explosives placed on the surface of two feet or more of snow results in good seismic data in some areas, while creating no visible surface disturbance.

The vibrations or waves traveling through the ground are recorded by seismographic units some distance away at several locations. The seismic sensors and energy source are located along lines on a one to two-mile grid. Existing roads are used if possible. Lines may require clearing of vegetation and loose rock to improve access for the trucks. Each mile of line cleared to a width of 8-14 feet represents disturbance of about an acre of land.

In remote areas where there is little known subsurface data, a series of short seismic lines may be required to determine the regional dip and strike of subsurface formations. After this, seismic lines will be aligned with these formations to make seismic interpretation more accurate. Although alignment may be fairly critical, spacing of the lines can often be changed up to a quarter of a mile on a one-mile grid, before the results will affect the investigation program.

A network of low standard temporary roads and trails can result from this operation. Level topography with few trees and shrubs would require little or no road construction. An area with rugged topography and larger vegetative types such as trees and large shrubs would require more road preparations. Temporary roads and trails are usually constructed with bulldozers. The surface is cleared by removing vegetation and loose mineral material. Small streams and gullies are crossed by filling in the channel after placement of an appropriate culvert(s) or by dozing out the stream banks to provide a dip or gradual transition to enable equipment to cross. The alignment of these roads consists of straight lines, usually with little regard for gradient or steep slopes or rough terrain being traversed.

A typical seismic operation may use 10 to 15 men and five to seven trucks. Under normal conditions, three to five miles of line can be surveyed each day using the explosive method; five to ten miles are about average for a vibrator crew. The crews often work 70 to 80 hours a week in good weather.

If preliminary investigation on BLM lands does not result in significant impacts on the surface, the operator need not notify the district BLM office. However, if the investigation will create noticeable impacts (e.g., road construction or ground clearing), as it could in seismograph prospecting, the operator must be properly bonded and must file a Notice of Intent. Bonds may be in the form of a rider on existing nationwide or statewide oil and gas bonds. BLM personnel will then examine resource values in the area and stipulate appropriate surface protection and reclamation requirements. The operator notifies the district manager before entry onto the land. It should be noted that the U.S. Forest Service requires a Prospecting Permit for virtually any oil and gas activity on lands it administers.

During preliminary investigation, the operator will comply with the stipulations for surface protection and reclamation. The BLM is responsible for checking this compliance. The operator notifies the district of any proposed changes in his activity. At the end of the investigation, the operator files a notice of completion, the BLM makes a final inspection, and, if all requirements have been met, the operator's bond is released.

Since no statutory authorization is required for entry on the land, avoidance of adverse impacts is dependent on the cooperation of oil and gas exploration operators. However, rehabilitation of damage can be required by the government.

Exploratory Drilling

Drilling does not begin until a lease has been acquired by the operator. In cases where preliminary investigations are favorable and warrant further exploration, exploratory drilling may be justified. Figure 1-16 shows a typical exploratory rig working in prairie country. More precise data on the geologic structure is obtained by stratigraphic tests using shallow drill holes.

Additional subsurface information revealing the nature of near surface structural features may be obtained by drilling holes to depths of 2,000 to 3,000 feet or deeper. Drilling is accomplished primarily by rotary drill rigs. Rock chips and cuttings are brought to the surface from the bottom of the drill hole by high-pressure air flow or a flow of drilling mud. The chips and cuttings are collected, bagged, and identified as to depth of their origin. The chips are then examined to determine their composition and age, which helps to identify the formation and structure from which the chips originated. This kind of information will help the geologist find a marker zone or formation to correlate the previously obtained geologic and geophysical information to actual structures.

Temporary roads good enough to accommodate truck mounted drill rigs, water trucks, and other service equipment must be constructed. Where level, solid ground exists, little road construction is usually necessary. In hilly or mountainous areas, more road building would be necessary. Figure 1-17 shows an oil and gas access road in a mountainous area.

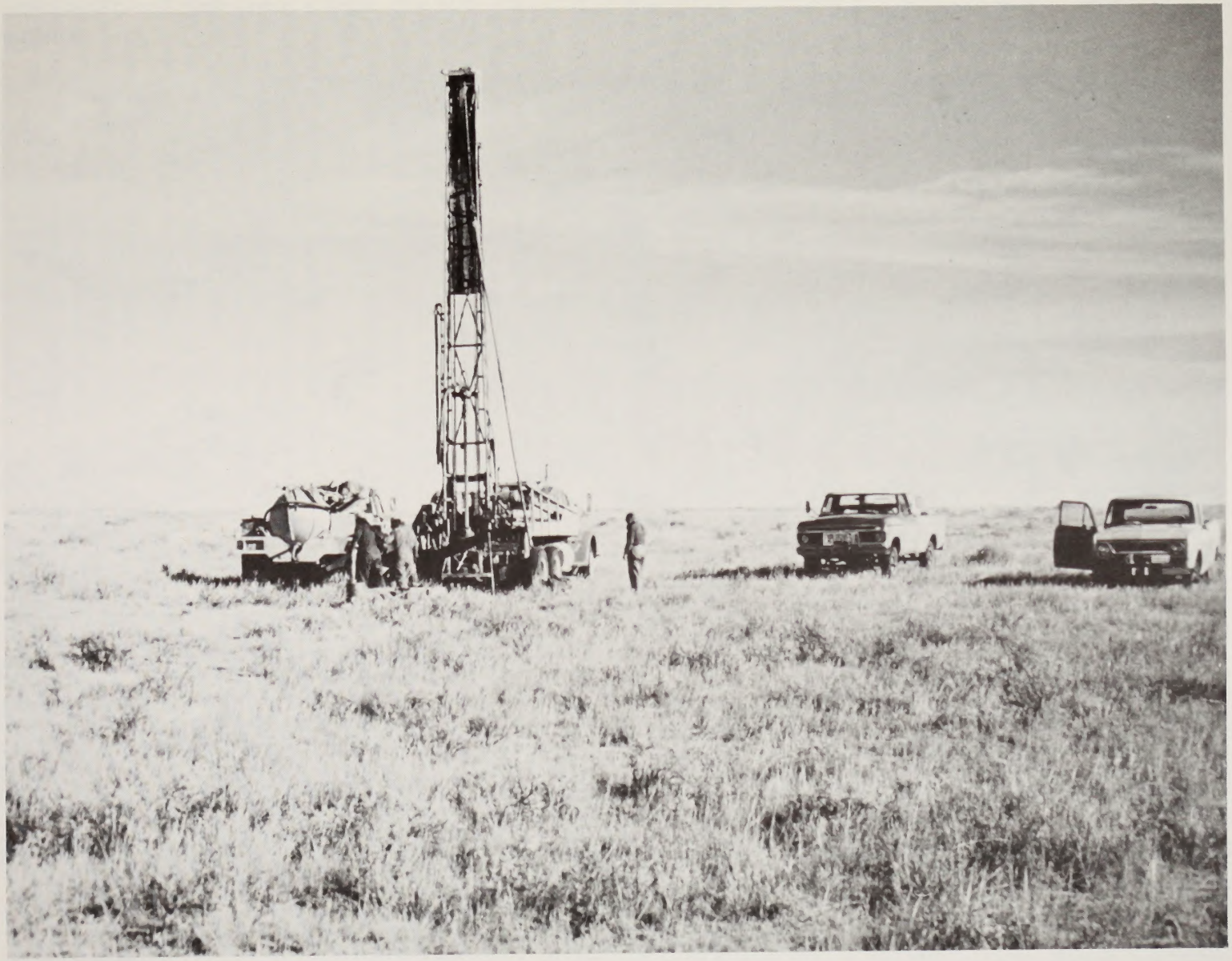


Figure 1-16
Exploration Drill Rig
SOURCE: BLM



Figure 1-17
Road Built During Exploratory Activity
SOURCE: BLM

A space of about one-half acre or less is leveled and cleared of vegetation for the average drill site. If high pressure air is used to remove rock chips or rock cuttings, rock dust may be emitted to the air when samples are not being collected. If mud is used as a drilling fluid, mud pits may be excavated; more commonly, portable mud tanks are used. Usually, one to three days are required to drill the test holes.

Oil and gas are found in small spaces in porous rock somewhat like water in a sponge. It seeps slowly through the porous material until it is trapped by impervious rock, often appearing as a layer between water and gas. The preliminary exploration is done in an attempt to tentatively locate these traps. If preliminary exploration still indicates the possible existence of oil and gas, a "wildcat well" (i.e., a well drilled outside of a Known Geologic Structure) will be drilled into the suspected zone to determine if in fact the oil and/or gas are present and if its quality and quantity is adequate for profitable sale.

Nationally, approximately 1 out of every 16 wildcat wells produce significant amounts of oil or gas. Only 1 out of 140 wildcat wells produces enough to be financially successful. In recent years, success ratios for the three-state study area were considerably higher. During 1977, Montana's wildcat success rate was 25%, North Dakota's rate was 17%, and South Dakota's rate was 32%.

The depth of wildcat wells depends on the geology of an area. In the Williston Basin and Overthrust Belt areas, wells are commonly drilled to a depth of 10,000 feet or more. Drilling equipment could remain on this type of site for six months, while in other areas such as the northern part of Montana, shallower wells up to a few thousand feet are common and may be completed in a few weeks.

Prior to drilling, an area or drill pad must be cleared and leveled for drilling equipment. The well site, usually one to four acres, is cleared of all vegetation and graded nearly flat for the drilling rig, mud pumps, mud pit, generators, pipe rack, and tool house. Other facilities such as storage tanks for water and fuel are located nearby.

From 50,000 to 100,000 gallons of water a day may be needed for mixing drilling mud, cleaning equipment, cooling engines, etc. A surface pipeline may be laid to a stream or a water well, or the water may be trucked to the site.

A drilling rig may be moved from one site to the next after being dismantled. In some instances, rigs can be skidded short distances in level terrain which will shorten the tearing down and rigging up time. Moving a dismantled rig involves use of heavy trucking equipment for transportation and crews to erect the rig.

In order to move a drilling rig from one drill site to another, temporary roads with a capacity sufficient to haul the drill rig, well service equipment, and to accommodate continuous traffic to and from the drill site are built (Figure 1-18). Time of year, topography, and duration of drilling activity are other factors which influence how the road is constructed.

Typically, a temporary road would not exceed 16 feet in width. In general, temporary roads should be designed for the minimum width needed for the activity. Turnouts, as shown in Figure 1-19, are made on single lane roads, blind curves, and approximately every 1,000 feet along the road. In hilly or mountainous areas, it may be necessary to cut and fill slopes. Cut slopes up to 3:1 (three feet horizontal and one foot vertical) and fill slopes of 2:1 are common. Construction of a road 16 feet wide would require approximately 1.9 acres per mile of road.

A single lane road with a ten foot wide running surface would require about 1.5 acres of surface per mile, plus road cuts and fills. In hilly and mountainous areas, the surface areas required for a road would increase depending on the topography and the number of cuts and fills. Bulldozers, maintainers, and other types of heavy construction equipment would be needed to construct and maintain temporary wildcat well roads. A part of this activity would include necessary culvert installation, setting of timbers, etc.

Drilling is started by "spudding in" the well; that is, starting the hole. Oftentimes, a short piece--10 to 12 feet--of conductor pipe is forced into the ground. Conductor pipe may be cemented by hand, driven into place using a piledriver, or it may be cemented in a hole drilled in the usual manner. The initial drilling usually proceeds rapidly and generally the string of surface casing is set before harder, deeper formations are encountered. The surface casing is a long length of steel pipe which is cemented into the well to protect against water or rock getting into the hole. It is smaller in diameter than the conductor pipe but large enough to allow subsequent lengths of casing to be set as the well is deepened. Also, surface casing provides for attachment of blowout preventers that are necessary in case a zone containing high-pressure gas, water, or oil is encountered. Without blowout protection, the contents of this zone could blow all the drilling mud out of the well (Figure 1-20).

During or at the completion of drilling, the well is logged. Logging involves the measuring of physical characteristics of the rock formations and associated fluids, with instruments lowered to the bottom of



Figure 1-18

Temporary Road Built for Hauling Drilling Equipment from One Site to Another

SOURCE: BLM

FIGURE 1—19

TEMPORARY ROADS

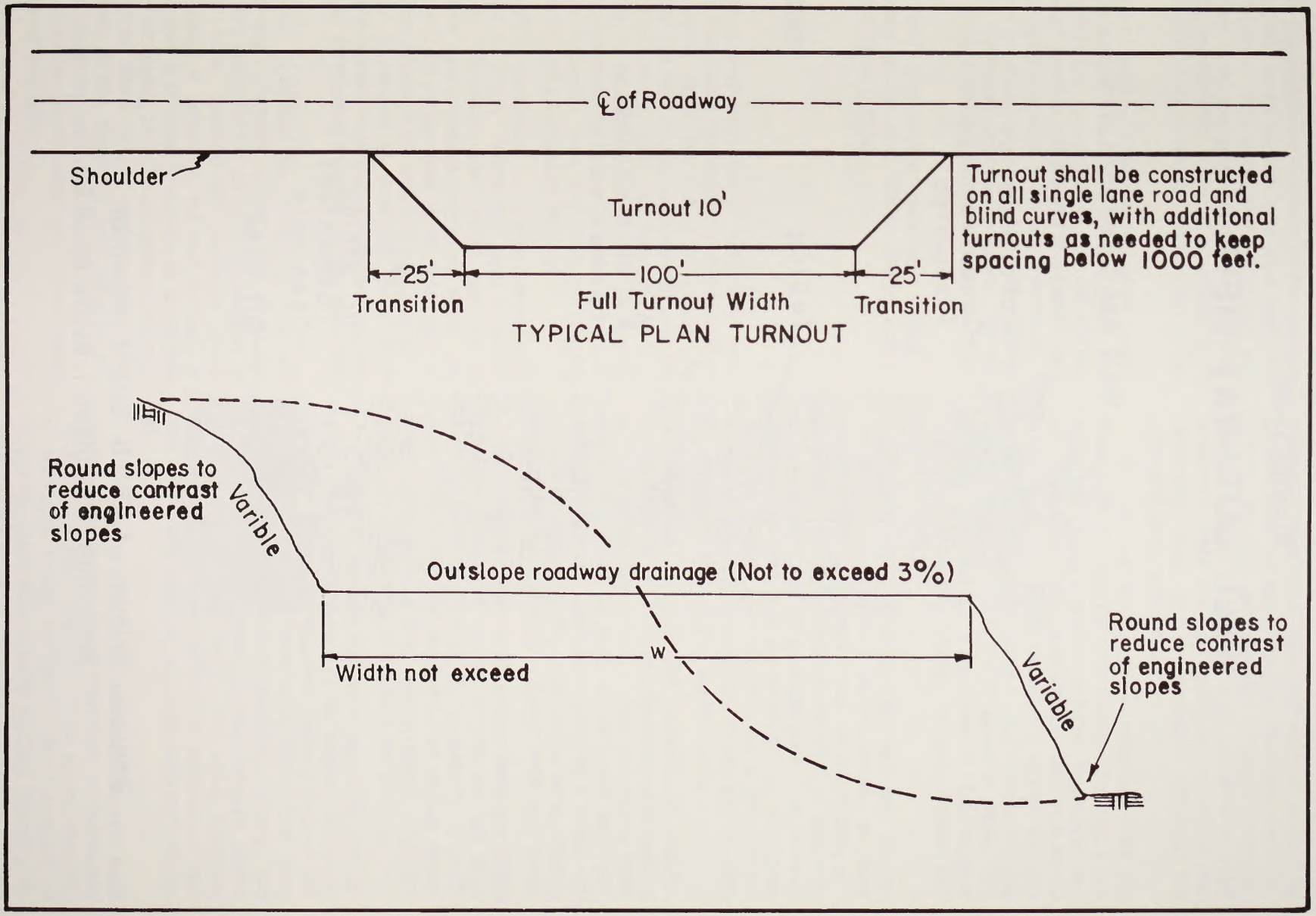
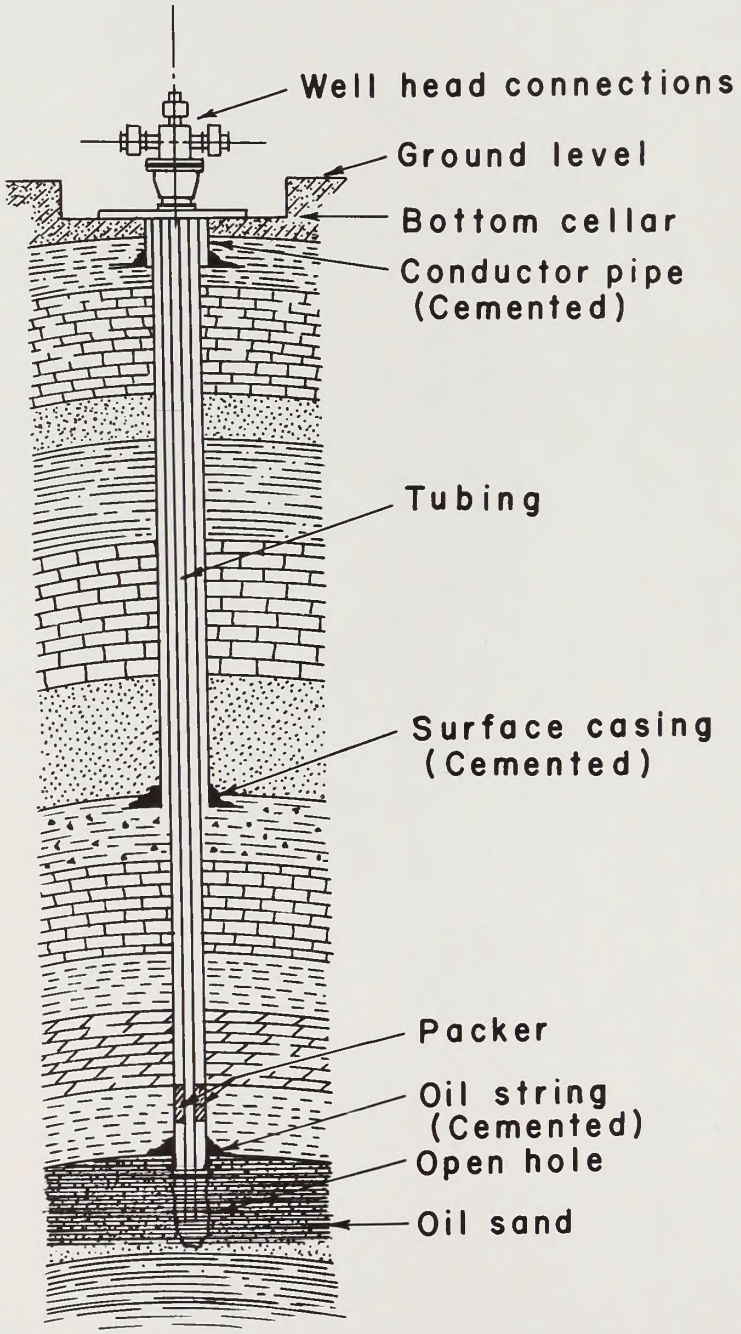


FIGURE 1—20

WELL CUTAWAY VIEW



Source: Primer of Oil & Gas Production,
American Petroleum Institute, 1978.

the well. As the equipment is raised to the surface, the instruments record various data from each formation of interest. After study of the well logs and drill stem test data, the geologist decides whether the well has encountered sufficient quantities of oil or gas in a pay zone to warrant completion of the well.

Completion requires installation of steel casing between the surface casing and the pay zone. The casing is selectively cemented, to provide stability and to protect specific zones, and then perforated adjacent to the suspected producing formation. If the formation produces oil or gas, the area is developed. If the formation does not produce, the well may either be extended to a greater depth or abandoned.

During 1977, 259 wildcat wells were drilled in the three-state study area. Other drilling activity was in known fields (KGSs).

Development

If a wildcat well becomes a "discovery" well (i.e., a well that yields commercial quantities of oil and gas), other wells are drilled to locate the boundaries of the field and to facilitate planning the best pattern of wells to drain the reservoir. As with wildcat wells, a field development will be staked and its exact location determined by surveyors, relative to land boundary lines and other geographic "fixes" tied into the geophysical surveys.

If the well is completed as a free-flowing well, the wellhead is simply closed off using a device known as a "Christmas tree" which consists of various valves and pressure regulators which are used to control oil or gas flow to facilities used in the production phase. If the well is a gas discovery, the operator is allowed to flare gas for a short period of time to determine capacity before shutting the well in or connecting the well to gas gathering pipelines.

Quite often, however, the producing zone will not have enough pressure to force the oil to the surface. In this situation, the oil must be pumped to the surface using "artificial lift" methods. When pump installation is complete, the well normally is tested for a period of days or months to determine whether the producing zone is adequate to support additional wells. More detailed seismic lines tying previous lines to the discovery well may be required. The discovery well may also be studied to draw upon previous seismic work and provide more accurate subsurface data.

A temporary well spacing pattern must be established before development drilling begins. Information considered in establishment of a spacing pattern includes data from the discovery well concerning porosity, permeability, pressure, composition, and depth of formations in the reservoir; well production rates and type (predominately oil, or predominately gas); and the economic effect of the proposed spacing on recovery.

Oil and gas well spacing, established by the state with concurrence from GS, can be from a few acres per well to a section or more. In general, well density for gas wells is much less than that for oil wells. Typically spacing restrictions require that gas wells be sited on 160 acres or more while oil wells can be sited on tracts of 40 acres or more. This implies that, generally, a maximum of 16 oil wells or 4 gas wells can be located on one section (640 acres) of land.

Surface use in an oil and gas field also may be affected by unitization of the leaseholds. In many areas containing federal lands, an exploratory unit is formed before a wildcat is drilled. The boundary of the unit is based on geologic data. The developers "unitize" the field by entering into an agreement to develop and operate it as a unit, without regard to separate ownerships. Costs and benefits are allocated according to agreed terms.

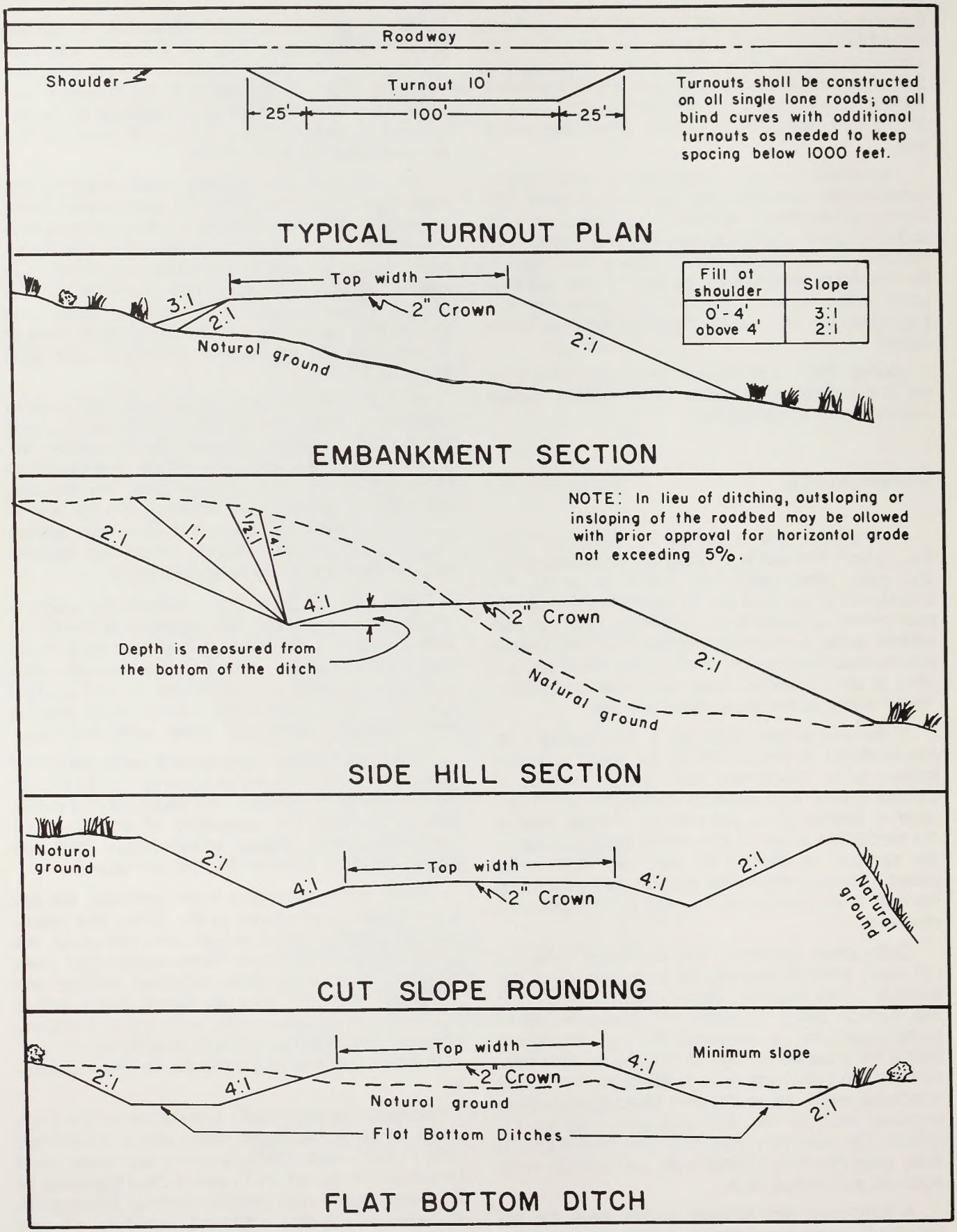
Unitization reduces the surface-use requirements because all wells are operated as though on a single lease. Duplication of field processing facilities is minimized, because development and operations are planned and conducted by a single unit operator. Unitization may also involve wider spacing than otherwise, resulting in fewer wells and roads.

The rate at which development wells are drilled depends on such factors as whether the field is on a lease basis or unitized, the probability of profitable production, the availability of drilling equipment, protective drilling requirements, and the degree to which limits of the field are known.

Once well spacing has been approved, the operator plans development of the lease. The procedures for drilling development wells are about the same as those for wildcat wells, except that there is usually less subsurface sampling, testing, and evaluation. Surface uses for development drilling may include access roads, well sites, flowlines, storage tank batteries, facilities to separate oil, gas, and water, and injection wells for saltwater disposal.

Normally, access roads are limited to one main route to serve the lease area with a maintained road to each well. Typically, roads are constructed to standards shown in Figure 1-21. Upgrading of temporary roads may include ditching, draining, installation of culverts, gravelling, crowning, or capping the roadbed. Surface area needed for roads

TYPICAL ROAD SECTIONS



Source: Bureau of Land Management, 1977.

would be similar to temporary roads and also dependent on how level or hilly an area may be.

When an oil field is developed on the spacing pattern of 40 acres per well, the wells are approximately 1,320 feet apart in both north-south and east-west directions. If a section (a square mile) is developed with 16 wells, at least four miles of access roads are built. Although the size of most fields ranges from less than 1,000 acres to several thousand, a few major fields cover several townships. If a major field is discovered and developed on a 40-acre well spacing pattern, a township may have 576 wells and over 200 miles of road.

The most important factor in further development may be the quantity of production. If the discovery well has a large capacity and substantial reserves are indicated, development drilling may occur at a much slower pace. An evaluation period to observe production performance may follow between the drilling of successive wells.

Development on an individual lease basis may proceed more rapidly than under unitization, since each lessee must drill his own well to obtain production from the field. On a unitized basis, however, all owners within the participating area share in a well's production regardless of whose lease the well is on.

Drilling in an undeveloped part of a lease, to prevent drainage of petroleum to an offset well on an adjoining lease, is frequently required in fields of intermingled federal and privately-owned land. The terms of federal leases require such drilling or compensatory royalty if the offset well is on nonfederal lands, or on federal lands leased at a lower royalty rate.

Many fields go through several development phases. A field may be considered fully developed and produce for several years, then wells may be drilled to a deeper pay zone. Discovery of a new pay zone in an existing field is a "pool" discovery, as distinguished from a new field discovery. A pool discovery may lead to the drilling of additional wells--often from the same drilling pad as existing wells--with the bore holes separated only by feet or inches. Existing wells may also be drilled deeper.

Production

Production in an oil field begins soon after the discovery well is completed and often concurrently with development operations. Temporary facilities may be used at first, but as development proceeds and reservoir limits are learned, permanent facilities are installed. The extent of such facilities is dictated by the number of producing wells, expected production, volume of gas and water produced with the oil, the number of leases, and whether the field is to be developed on a unitized basis.

Production in a gas field does not begin until the pipeline to a market has been constructed. Sales pipelines are not justified until sufficient gas reserves are proved by drilling operations. Gas wells are often shut-in after completion for periods ranging from months to years until pipeline connections are available.

Some natural gas contains hydrogen sulfide which is a highly toxic and flammable gas. Presence of hydrogen sulfide in a formation can cause problems while drilling, as well as during production. High carbon steel, used for drilling and casing deep holes due to its high strength, will shatter like glass when exposed to high concentrations of hydrogen sulfide. Natural gas containing significant amounts of hydrogen sulfide is known as "sour gas." The hydrogen sulfide must be removed before the gas enters a commercial pipeline. If sour gas is produced in quantities insufficient to justify this removal, it must be flared. If combustion during flaring is complete, only sulfur dioxide is emitted into the air. If incomplete combustion occurs, other sulfur compounds including hydrogen sulfide are emitted into the air. Oil wells producig from formations containing hydrogen sulfide represent a hazard to personnel if dissolved hydrogen sulfide is present in the oil. Hydrogen sulfide smells like rotten eggs in low concentration, but prolonged exposure tends to dull the sense of smell. Hydrogen sulfide is heavier than air and will concentrate in low-lying areas and depressions. Under certain conditions, it can form an explosive mixture with air in concentrations over four percent by volume. Drill crews are aware of this problem and take precautionary measures to avoid this occurrence. Gas sweetening plants may be built to produce elemental sulfur from hydrogen sulfide in the natural gas.

Most wells in the three state study area require an artificial lift to bring the oil to the surface. Pumping and a technique known as "gas lift" are the two artificial lifts used. Naturally flowing wells and wells with gas lift facilities use a minimum of equipment at the surface and produce little or no sound. All surface pump systems require more surface equipment and make more noise than flowing wells and gas lift facilities.

Surface pumps are usually powered either by electric motors or internal combustion engines. Operators prefer electric motors because they make less noise, require less maintenance, involve less fire hazard, are more dependable, and can be more easily automated than internal combustion engines. However, internal combustion engines must be used in many oil fields where electric power is not

available. If there is sufficient casing head gas (natural gas produced with the pumped oil), or another gas source is available, it may be used to fuel internal combustion engines. Butane and propane are also used as fuels. Single-cylinder engines operate at high noise levels, whereas multi-cylinder engines operate at lower noise levels.

Most existing wells in the three-state area have weak water pressure and require pumping. Both surface and subsurface (submersible) pumps are used; however, subsurface pumps are much less common. The horsehead pump (Figure 1-22) is most commonly used in the study area.

Surface units used with sucker rod pumps are fitted with guard rails, belt drive shields, and fences for safety. These pumps, as well as the accompanying tanks and other facilities, can be painted in earth tone colors to blend with the landscape.

Gas lift is used in some oil field where high pressure natural gas is available, and where pressure in the petroleum reservoir is sufficient to force the petroleum part of the way up the well. The addition of gas lowers the specific gravity of the petroleum so that it flows to the surface. However, this method will be used less in the future as supplies of high pressure natural gas decline.

Most gas wells produce by normal flow and do not require pumping. Surface use at a flowing well is usually limited to a 20-foot by 20-foot fenced area containing a gas well Christmas tree. If water enters a gas well and chokes off the gas flow, a pump may be installed to pump off the column of water. After the water is removed, the gas flows to the surface until water chokes it off again. Some gas wells may require almost continual water pumping.

Crude oil is usually transferred from wells to a central storage tank battery (Figure 1-23) before it is transported from the well site by truck or by pipeline.

Naural gas is often sold at the wellhead and transported directly off the lease. If processing is required to remove liquid hydrocarbons or water, however, the gas may be transferred to a central collection point prior to sale. On some leases, the production from several wells is piped to a central gathering station and then piped in a larger line to the storage batteries.

Pipelines used within the field are commonly from 4 to 6 inches in diameter between the well and gathering station. Pipelines between the gathering tanks and treating stations may be 4 to 8 inches in diameter. These pipelines may be buried without a protective coating in areas where soils are not corrosive. Briny water mixed with the oil can also corrode pipelines, causing them to wear out and develop leaks more rapidly. Such leaks are easier to detect and repair if the pipelines are placed on the surface rather than underground.

If the oil contains gas and water, they are separated before the oil is stored in the tank battery. The treating facilities are usually located at a storage tank battery (Figure 1-24).

Low pressure petroleum that must be pumped from the well is normally treated in a single separation; high-pressure flowing petroleum may require several stages of separation with a pressure reduction accompanying each stage.

If enough casinghead gas is separated in the field to make it economical to process it for marketing, a plant may be built to remove gasoline, butane, and propane. Some of the remaining gas is used to fuel the plant and the remainder is sold. If the volume of casinghead gas produced in a field is insufficient to warrant treatment in a gas plant, it is usually used as fuel for pump engines in the field and as heating fuel for oil treaters. If the gas exceeds fuel requirements on the lease, it may be flared or vented to the atmosphere.

If water is produced with the petroleum, it is separated before the gas is removed. In primary operations, where natural pressures or gravity cause the petroleum in the reservoir to flow to the wells, the degree of mixing usually is high enough to require chemical and heat treatment to separate the oil and water. Heat applied to the bottom of the treaters breaks the emulsion. The heat is supplemented in most cases by chemical emulsion breakers.

In secondary production, where water injection or other methods are used to force additional petroleum to the well bore, the oil and water often are not highly emulsified. In this case, the oil and water may be separated by gravity in a tall settling tank. Water injection may require additional wells and maintenance roads.

After the oil and water are separated, the oil is piped to storage tanks located on or near the lease. There are normally at least two tanks so that at least one tank can be filled as the contents of the other are measured, sold, and transported. The number and size of tanks vary with the rate of production on the lease, and with the extent of automation in gauging the volume and sampling the quality of the tank's contents.

Although most produced waters are brackish to highly saline, some are fresh enough for beneficial use. In the past, ranchers have filed claims on oil field water so they can use it for agricultural or livestock purposes. Montana, North Dakota, and South Dakota law require that disposal permits be obtained from the Department of Health and Envi-

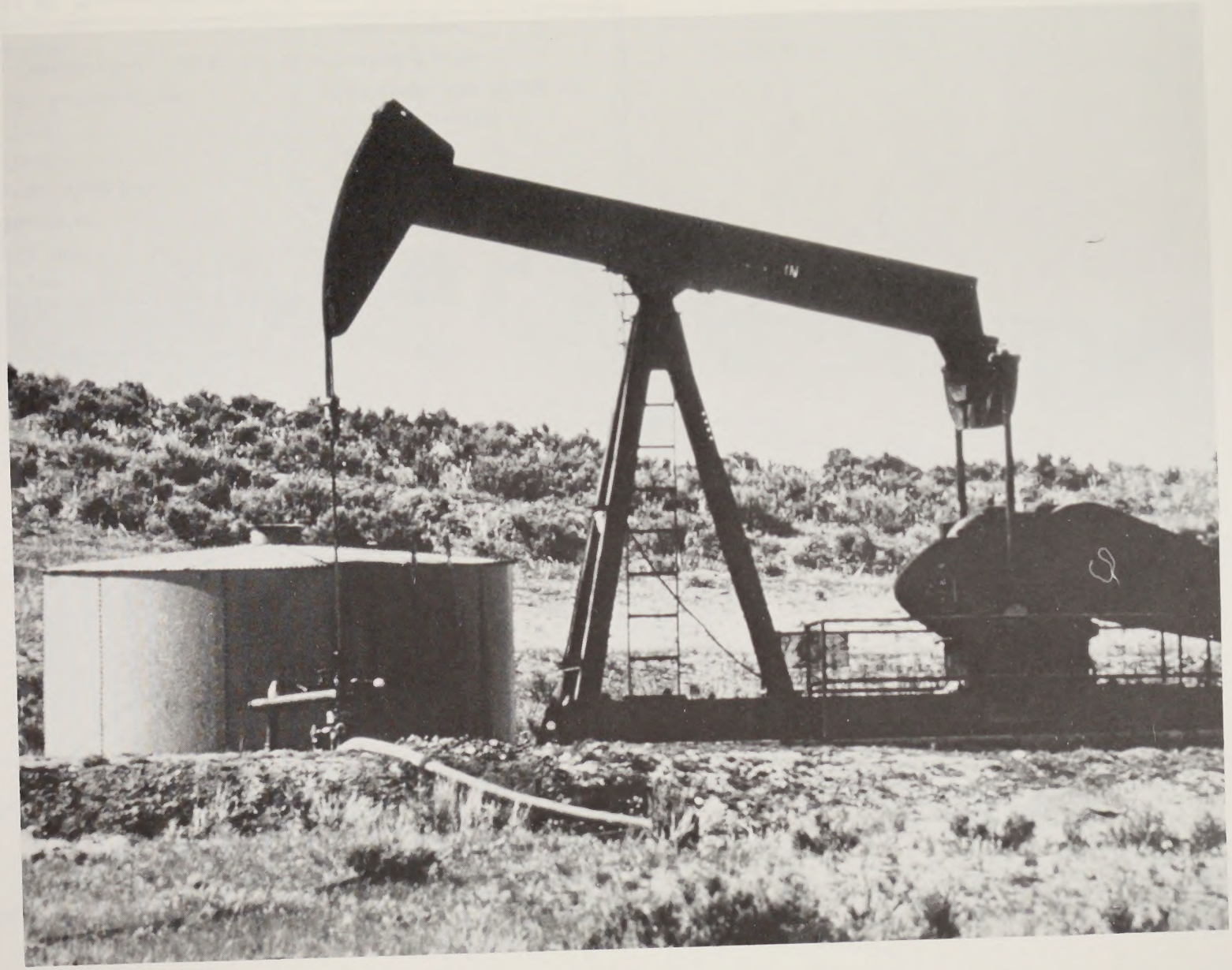
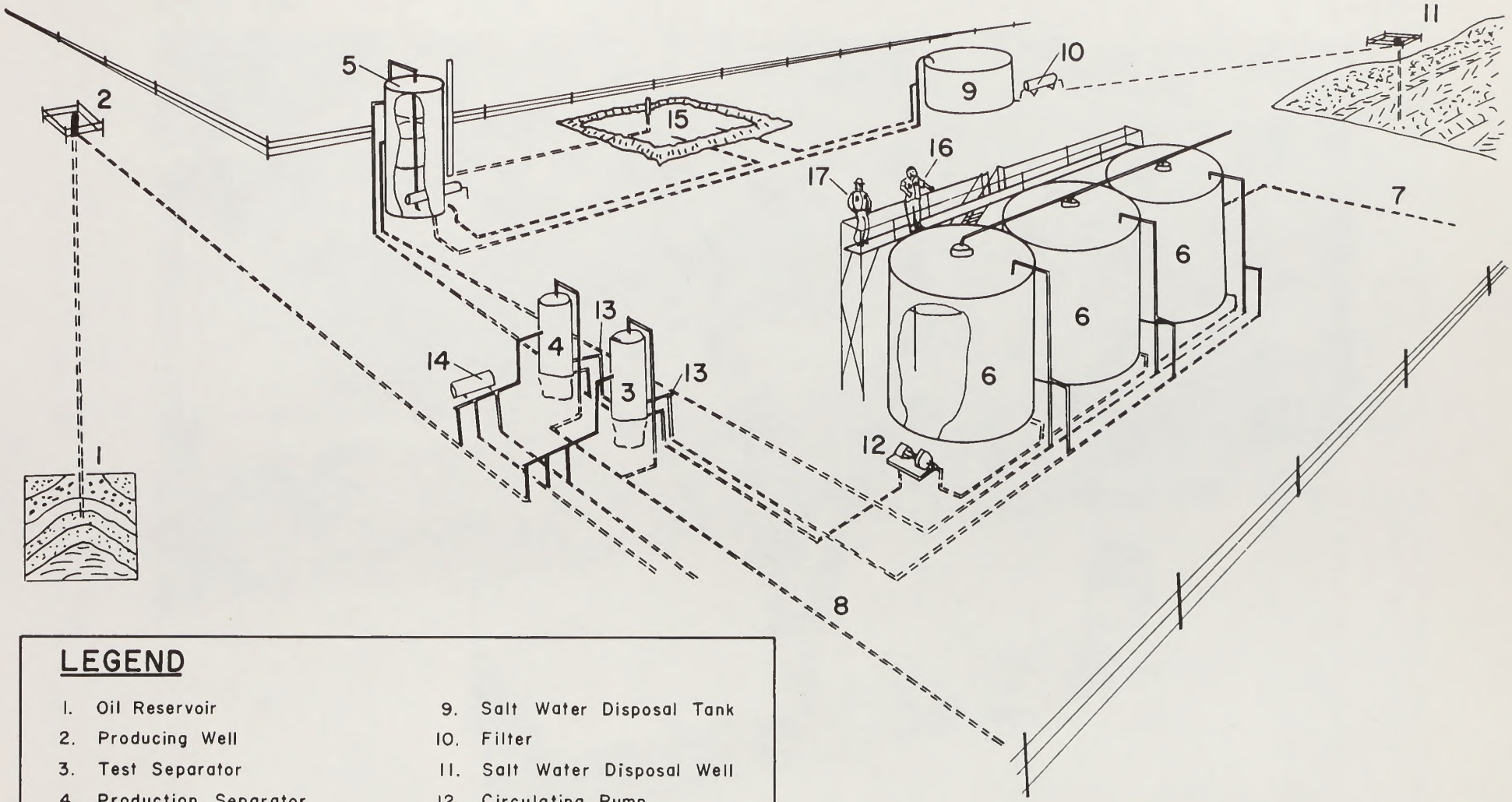


Figure 1-22
Horsehead Pump Used for Secondary Recovery
SOURCE: BLM

FIGURE 1–23

FLOWING OIL PRODUCTION



LEGEND

1. Oil Reservoir
2. Producing Well
3. Test Separator
4. Production Separator
5. Flow Treater
6. Stock Tank
7. Crude Oil Gathering Line
8. Gas to Gasoline Plant, Sales, or other uses
9. Salt Water Disposal Tank
10. Filter
11. Salt Water Disposal Well
12. Circulating Pump
13. Gas Meter
14. Chemical Injection
15. Emergency Salt Water Pit
16. Pipeline Gauger
17. Lease Pumper

Source: U. S. Department of Interior, 1963.



Figure 1-24
Oil Treatment Facilities Surrounding Storage Tanks
SOURCE: BLM

ronmental Sciences, Department of Health, and Department of Environmental Protection, respectively. The discharged water must meet certain water quality standards.

Because water may not come from heater-treaters completely free of oil, oil skimmer pits may be established between separating facilities and surface discharge.

When salt water is disposed of underground, it is usually introduced into a formation containing water of equal or poorer quality. It may be injected into the producing zone from which it came or into other producing zones. In some cases, this stimulates oil production. In other cases, it could reduce the field's productivity and may be prohibited by state regulation or mutual agreement of the operators.

In some fields, dry holes or depleted producing wells are used for salt water disposal; occasionally, new wells are drilled for disposal purposes. Cement is squeezed between the casing and sides of the well to prevent the salt water from migrating up or down from the injection zone into other formations.

Underground oil is usually under pressure. Drilling into the oil reservoir releases the pressure and allows oil to flow into the well where it rises to the surface. Oil recovery under natural pressure conditions is considered "primary" production. Primary production accounts for about 25% of the oil in a reservoir. In fields where it is economically feasible, "secondary" recovery methods are used. This involves pumping water or gas into the reservoir to increase oil production by increasing the pressure in the reservoir. "Tertiary" recovery methods can sometimes increase recovery rates if the viscosity of the oil is lowered so that it flows more easily either by heating the oil or by injecting chemicals into the reservoir. Heating of reservoir oil can be accomplished by injecting steam into the reservoir. Tertiary recovery methods are not yet widely used in this country. By the year 2000, reservoir production from any given oil reservoir is expected to average 40% nationally. Figure 1-25 shows primary, secondary, and tertiary methods of oil recovery. Secondary recovery is currently used in 103 (about 50%) of the oil fields in the three-state study area.

Waterflooding is the method used in about 90% of the three-state area's secondary recovery efforts. Water is injected into the reservoir to increase reservoir pressure and drive additional oil to the surface.

The water supply is usually a brine obtained by drilling in the waterflood area. Fresh water is not desirable for waterflood purposes because it may form chemical bonds with clays in some reservoir rocks and reduce the permeability of the reservoir formation. When fresh water is used, the amount is not large (50 to 10,000 gallons a day) when compared to other uses of fresh water such as agricultural irrigation. About 93 fields in the three-state area are injecting water for secondary recovery purposes.

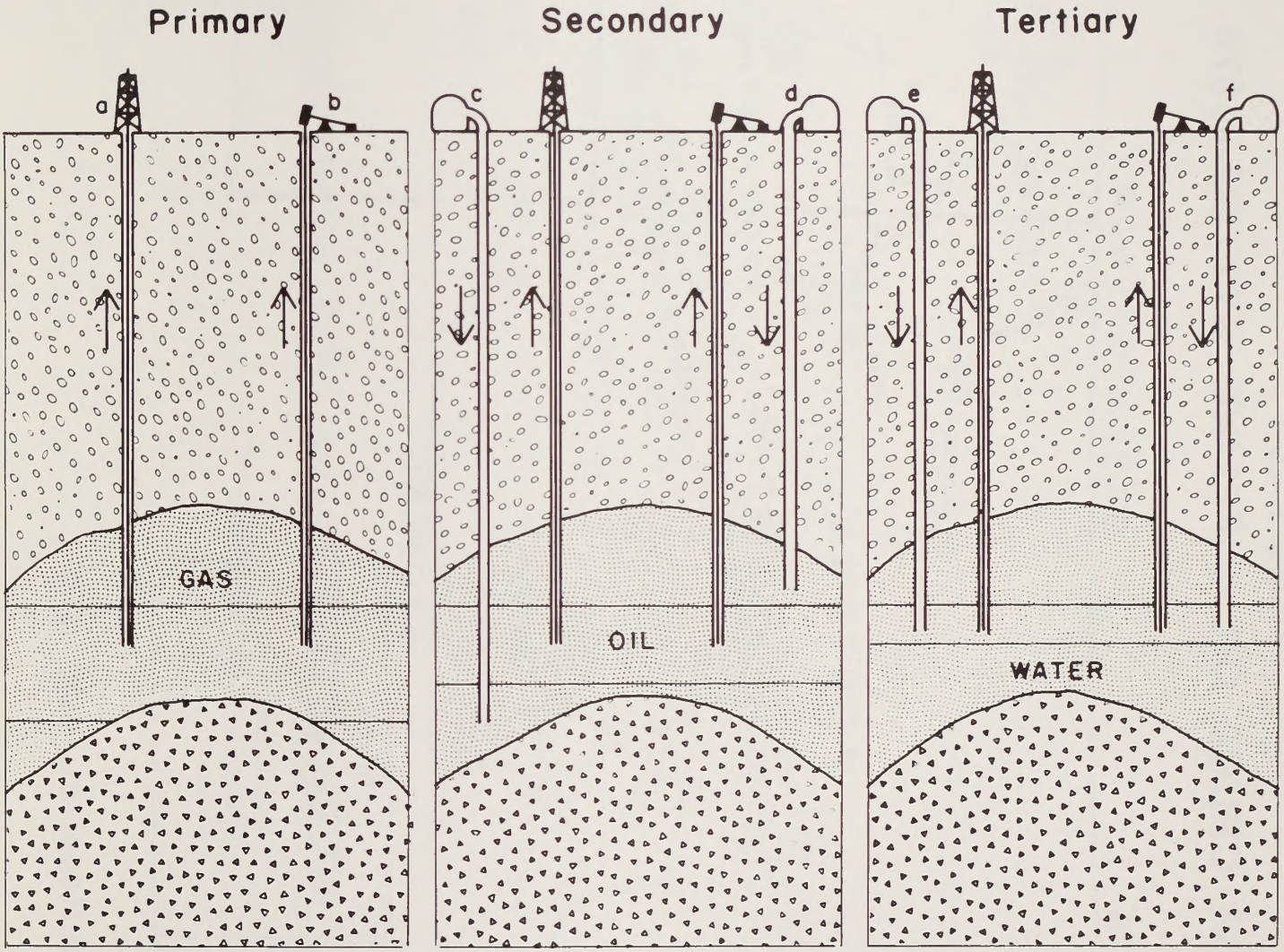
In some cases, formation fracturing is utilized. This is a method of stimulating production by increasing the permeability of the producing formation. Under extremely high hydraulic pressure, a fluid (such as water, oil, alcohol, dilute hydrochloric acid, liquefied petroleum gas, or foam) is pumped downward through tubing or drill pipe and forced into the perforations in the casing. The fluid enters the formation and parts or fractures it. Sand grains, aluminum pellets, glass beads, or similar materials are carried in suspension by the fluid into the fractures. These are called propping agents or proppants. When the pressure is released at the surface, the fracturing fluid returns to the well, and the fractures partially close on the proppants, leaving channels for oil to flow through them to the well. This process is often called a frac job. In most cases, this procedure requires significantly more land disturbance associated with preparing the drilling area because of the additional tanks and pumps required for the fracturing process.

Pipelines are needed to transport the oil from gathering stations to refineries. Figure 1-26 shows the existing oil pipeline network in Montana and North Dakota. As existing fields increase production or new fields begin production, new pipelines will be needed. These new lines would vary in size from 4 to 16 inches in diameter ranging in length from a few miles to tie into an existing pipeline, or hundreds of miles to supply an oil refinery. Crude oil lines are usually buried. Construction of a pipeline requires excavating and hauling equipment, temporary and permanent roads, pumping stations, clearing the right-of-way of vegetation, and possibly blasting. Figure 1-27 shows a typical pipeline construction spread while Figure 1-28 shows the laying out of pipe along the proposed route.

Pipelines for natural gas also would be needed to transport the gas from gas fields to the market place. Figure 1-29 shows the existing natural gas pipeline system in the three-state area. As with oil pipelines, the diameter and length would vary. Compressor stations may be necessary to increase production pressure to the same level as pipeline pressure and to maintain pipeline pressure. Construction techniques for natural gas lines are similar to those used for oil pipelines.

FIGURE 1–25

METHODS OF OIL RECOVERY

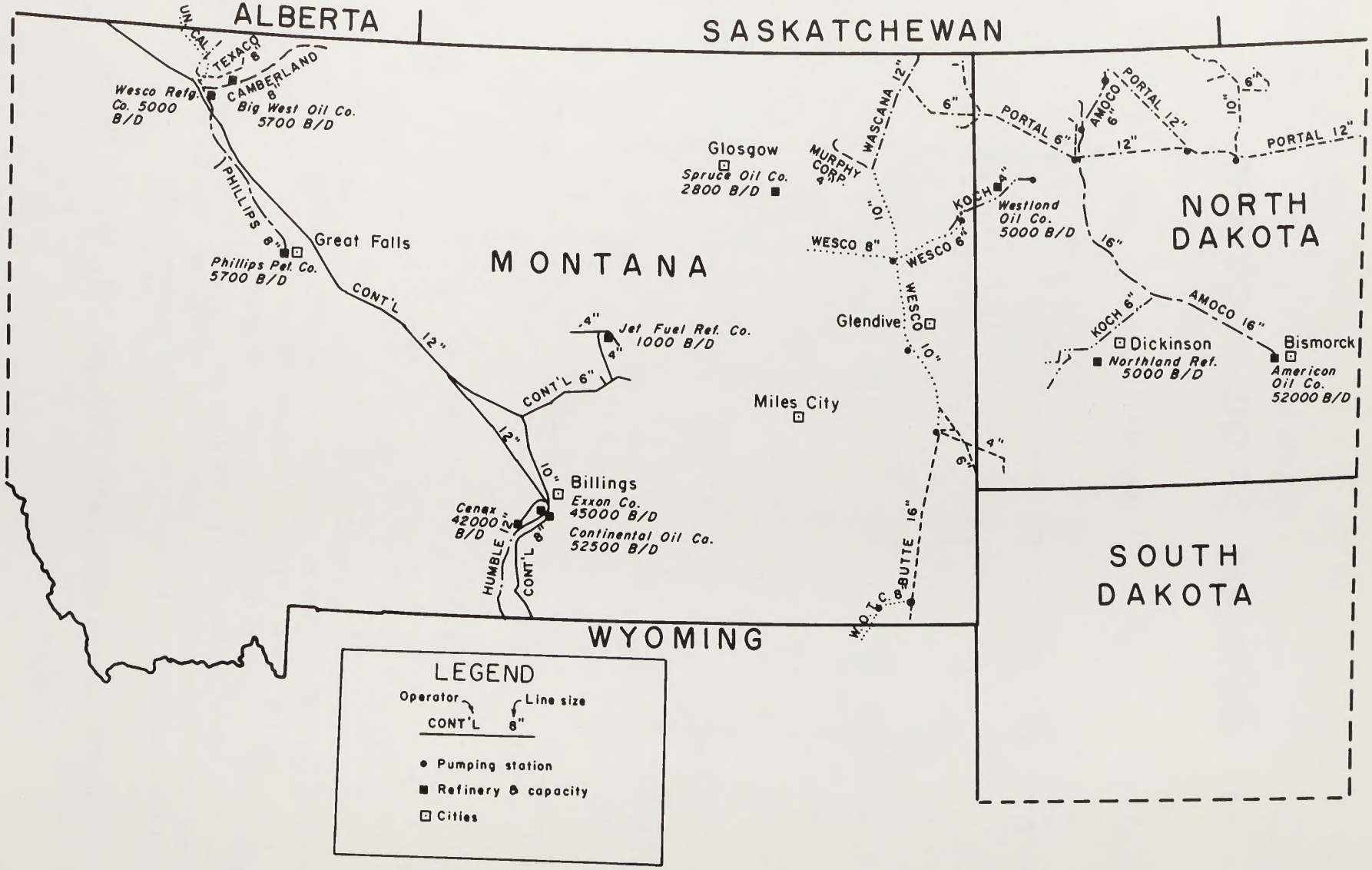


Oil is generally found under pressure in porous rock, often in a geological structure such as the one shown here. Drilling a well into the oil-bearing stratum releases the pressure, and in primary production the oil flows to the surface (a) or is pumped out (b). When the natural pressure is too low to bring the oil to the well, secondary recovery may be achieved by pumping water (c) or gas (d) into the field to increase the pressure. In tertiary recovery the oil's viscosity is lowered by injecting steam, which heats it (e), or by injecting a chemical (f).

Source: Scientific American, vol. 238, no. 38, March 1978.

FIGURE 1–26

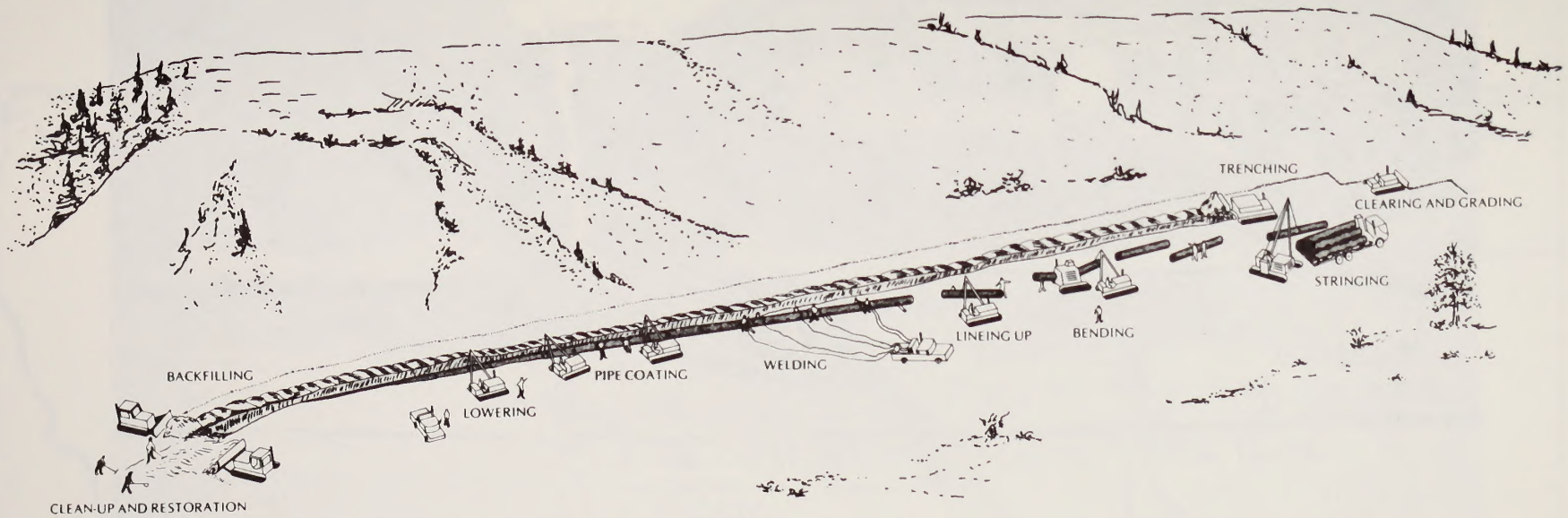
MAJOR CRUDE OIL PIPELINE SYSTEM—1976



Source: Western Oil Reporter, July, 1976.

FIGURE 1–27

TYPICAL PIPELINE CONSTRUCTION PROCEDURES



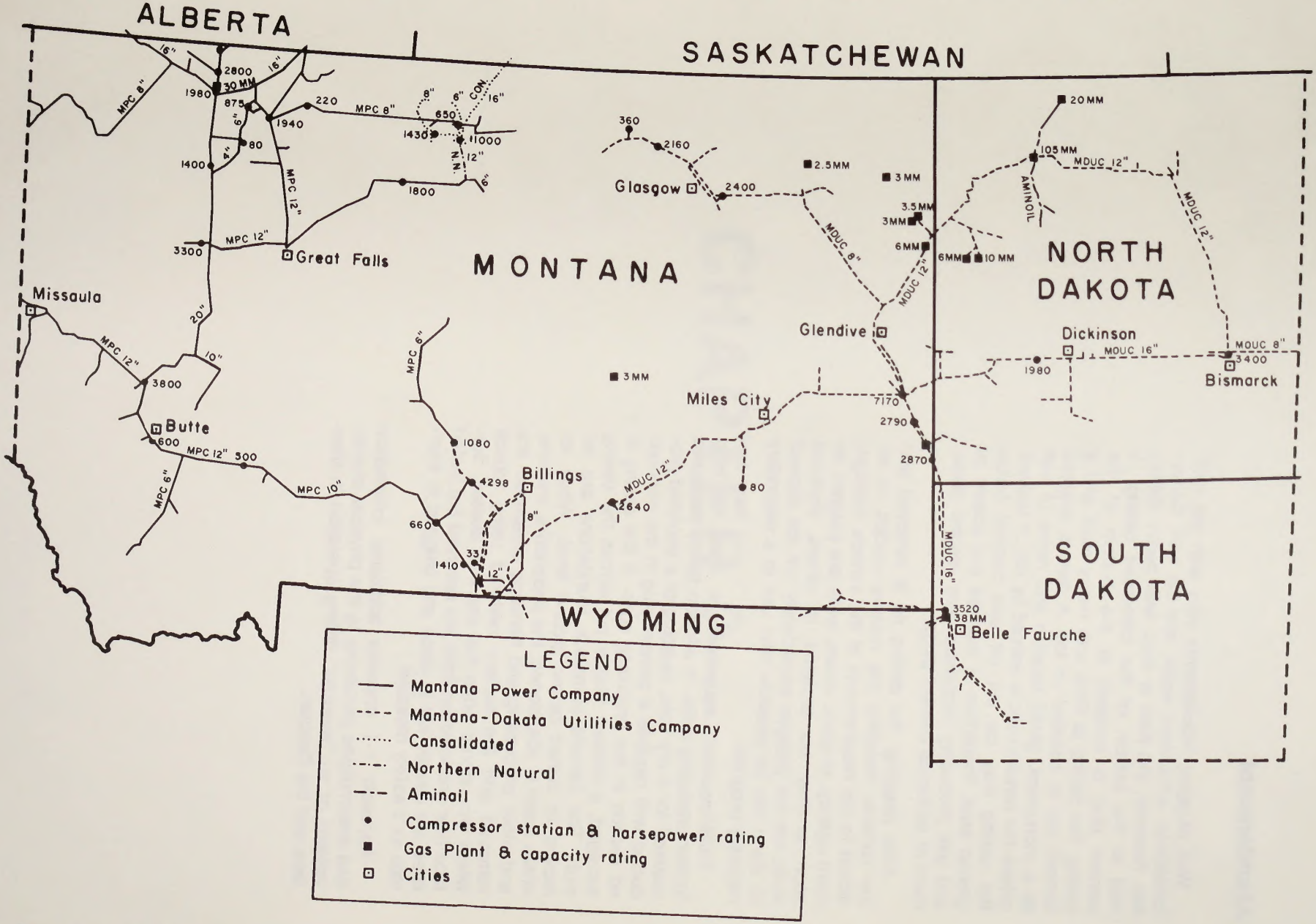
SOURCE: Modified From American Natural Gas Co., ANG Coal Gasification Co. 1977



Figure 1-28
Oil Pipeline Route Awaiting Assembly and Burial
SOURCE: BLM

FIGURE 1–29

MAJOR NATURAL GAS PIPELINE SYSTEM—1976



Source: Western Oil Reporter, February, 1977.

Abandonment

Well plugging requirements vary with the rock formations, subsurface water, and the well. Generally, however, the hole is filled with heavy drilling mud to the bottom of the cemented casing. A cement plug is installed at the bottom of the casing, the casing is filled with heavy mud, and a cement cap is installed on top. A pipe is required as a monument, giving location and name of well unless the requirement is waived by GS. If waived, the casing may be cut off and capped below ground level. Protection of aquifers and known oil and gas producing formations may require placement of additional cement plugs.

After plugging, the drilling rig is removed and the surface, including the reserve mudpit, is restored to the requirements of the surface management agency. In some cases, wells are plugged as soon as they are depleted. In others, depleted wells are not plugged immediately but are allowed to stand idle for possible later use in a secondary recovery program.

Truck-mounted equipment is used to plug former producing wells. In addition to the measures required for a dry hole, plugging of a depleted producing well requires a cement plug in the perforated section in the producing zone. If the casing is salvaged, a cement plug is put across the casing stub. The cement pumpjack foundations are removed or buried below ground level. When an entire lease is abandoned, the separators, treaters, and other processing and handling equipment are removed and the surface restored using topsoil which was stored when the site was leveled. Surface flow and injection lines are removed but buried lines are usually left in place and plugged at intervals as a safety measure.

Appendix 1-1 presents additional information and assumptions pertaining to the physical characteristics of an "average" drilling operation in Montana and the Dakotas.

CHAPTER 2

CHAPTER 2

INTRODUCTION

At present, oil and gas activity is significant within the Miles City District. The district produced approximately 21 million barrels of oil and 8.5 million mcf of natural gas in 1977. Of these two amounts, production of federal oil and gas amounted to 5.1 million barrels (24%) and 1.7 million mcf (20%), respectively. Bell Creek, Montana's largest oil field, lies within the Miles City District. This field produced 9.1 million barrels in 1977, approximately 34% of the district's oil production in that year.

In wildcat areas (i.e., areas outside Known Geologic Structures (KGSs)), the drilling success rate in 1977 for the district was 31%. Inside KGSs, the success rate was 56% (i.e., 48 producers out of 86 attempts). There were 138 wells drilled in 1977 for a total annual footage of 1,028,888 and an average depth of 7,500 feet. The above figures are up dramatically from 1974 when only 85 wells were drilled in the district for a total footage of 523,596. The average well depth in 1974 was 6,200 feet, 1,300 feet shallower than the 1977 average. Success rates were much lower in 1974 in wildcat areas (7%), and only slightly lower in KGS areas (63%).

Oil production in the district has declined slightly from 1974 to 1977 (22.5 million barrels versus 21 million barrels) in the presence of increased drilling activity. It is expected that drilling activity will continue to increase in the future as the search for domestic oil and gas continues to gain momentum.

Eastern and southeastern Montana as well as western South Dakota are the areas analyzed for potential impacts in this oil and gas environmental assessment. Figure 2-1 shows this study area lying within the larger overall boundary of the Miles City District. It should be noted that this assessment assumes that each oil and gas lease issued by the Bureau of Land Management carries with it the possibility of eventual development and production.

2.1 IMPACT SUMMARY

The following summary presents the impacts considered most significant within each environmental component as a result of the Proposed Action occurring within the Miles City District oil and gas study area. The reader is urged to consult the Environmental Impact Assessment section of this chapter for an area-specific description of environmental sensitivities within the study area.

Geology

Impacts could occur on paleontological features within the study area resulting from the full range of surface disturbing actions associated with oil and gas activities.

Soils

Impacts would result in certain areas depending upon slope, rainfall, inherent soil characteristics, and vegetative cover. Soil productivity would be lessened from compaction, use of inferior fill material and spillage of fuel, drilling fluids, and crude oil.

Topography

No significant impacts are expected.

Vegetation

Impacts would result from the direct destruction of plant cover from all phases of oil and gas activities. The area-specific magnitude of impacts depends upon slope, climatic conditions, soils, and vegetative types involved.

Water

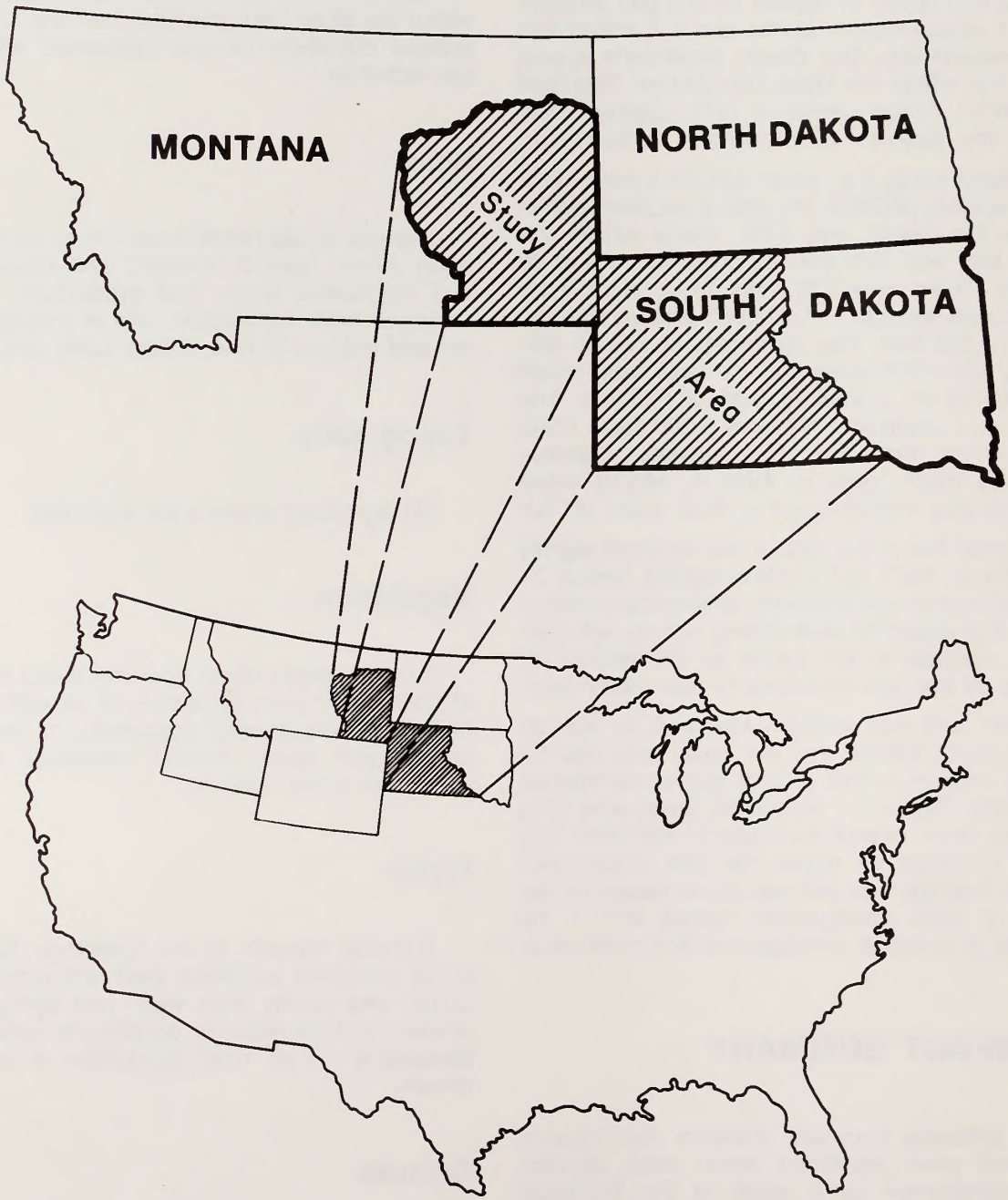
Possible impacts to the hydrologic features include increased sediment yield and reduced water output and quality from wells and springs. Downstream contamination is possible in certain areas, particularly on or near floodplains if an oil spill occurs.

Animals

Road construction and pad construction, resulting in habitat and forage loss and increased levels

FIGURE 2–1

MILES CITY DISTRICT AND STUDY AREA ENVIRONMENTAL ASSESSMENT OF OIL AND GAS LEASING



of human activity during all phases of oil and gas work would impact animals. Human intrusions into critical winter range or breeding areas during high use periods can have serious impacts on certain species.

Recreation

Only minor direct impacts expected.

Visual Resource Management

Impacts would occur primarily in the long term. The badlands, scablands, and heavily forested areas are those most likely to be impacted. The field development phase would generate the greatest impacts with road building and pipeline construction being the major impact causing actions.

Wilderness

Major impacts would be changes in the natural appearance of the landscape in the area and the loss of solitude resulting from oil and gas activity.

Prehistoric and Historic Features

Major impacts to cultural features could include loss of spatial association of artifacts and the destruction of the artifacts themselves, particularly in areas of known high site density.

Economic and Social Conditions

Economic and social impacts would center around population growth in communities which do not have excess housing and service (schools, sewage treatment, water supply, etc.) capacity. Peak impacts would occur during the labor intensive development phase.

Land Use

Land use impacts would involve conflicting land uses near communities which could experience expansion as a result of oil and gas activity and reductions in forage and agricultural production.

2.2 ENVIRONMENTAL IMPACT ASSESSMENT

Introduction

This section describes the districtwide environmental impacts that could result from continued leasing of federal oil and gas resources in the Miles City District. The impacts are those that could occur based on current oil and gas operating procedures and technological constraints. Within each environmental component, the discussion of impacts is arranged according to the phase(s) of oil and gas activity from which impacts are likely to occur. In some cases, discussions by activity have been combined within a component to avoid duplication. The five phases of onshore oil and gas activities which can result in environmental impacts include: preliminary exploration, exploratory drilling, development, production, and abandonment. A detailed description of these phases appears in Chapter 1, Proposed Action, under the heading "Phases of Onshore Oil and Gas Activity."

The impact assessment is complemented by the Miles City District Oil and Gas Map Overlay File. This is a 1/2-inch to the mile mapping system designed to present more detailed, area-specific environmental sensitivity ratings for each of the environmental components. This File is designed to be an up-to-date and accurate representation of oil and gas related environmental sensitivity in the Miles City District and will be revised as new resource information becomes available.

The environmental analysis which follows is arranged by environmental component in the following order: Geology, Soils, Topography, Vegetation, Water, Animals, Recreation, Wilderness, Visual Resource Management, Prehistoric and Historic Features, Economic and Social Conditions, and Land Use.

Geology

Knowledge gained from oil and gas development would probably surpass any negative impacts to the geologic features. Knowledge would be gained concerning the structure, stratigraphy, and hydrologic history of the area through surface exploration activity, followed by deep exploratory drilling and geologic interpretation of the information gathered. In addition, mineral resources other than oil and gas may be discovered through oil and gas activity itself, and the nation would benefit from the utilization of the petroleum resources.

Paleontological features are perhaps the only geologic resource which could be adversely impacted by surface disturbing activities. Fossils could be destroyed, and the stratigraphic arrangement disrupted. Figure 2-2 shows an example of sensitive paleontological areas within the study area.

Many fossils, however, would have never been discovered if it were not for surface disturbing activities of the sort associated with oil and gas work. Therefore, beneficial impacts may occur from exposure of subsurface material as well as geologic interpretation of data collected through the exploration and development activities. This new information would benefit the historic knowledge of depositional environments, structure, stratigraphy, and fossil evolution.

Impacts could occur from oil/gas activity conflicting with the development of other mineral resources. This could include, but is not limited to, conflicts with uranium or bentonite development.

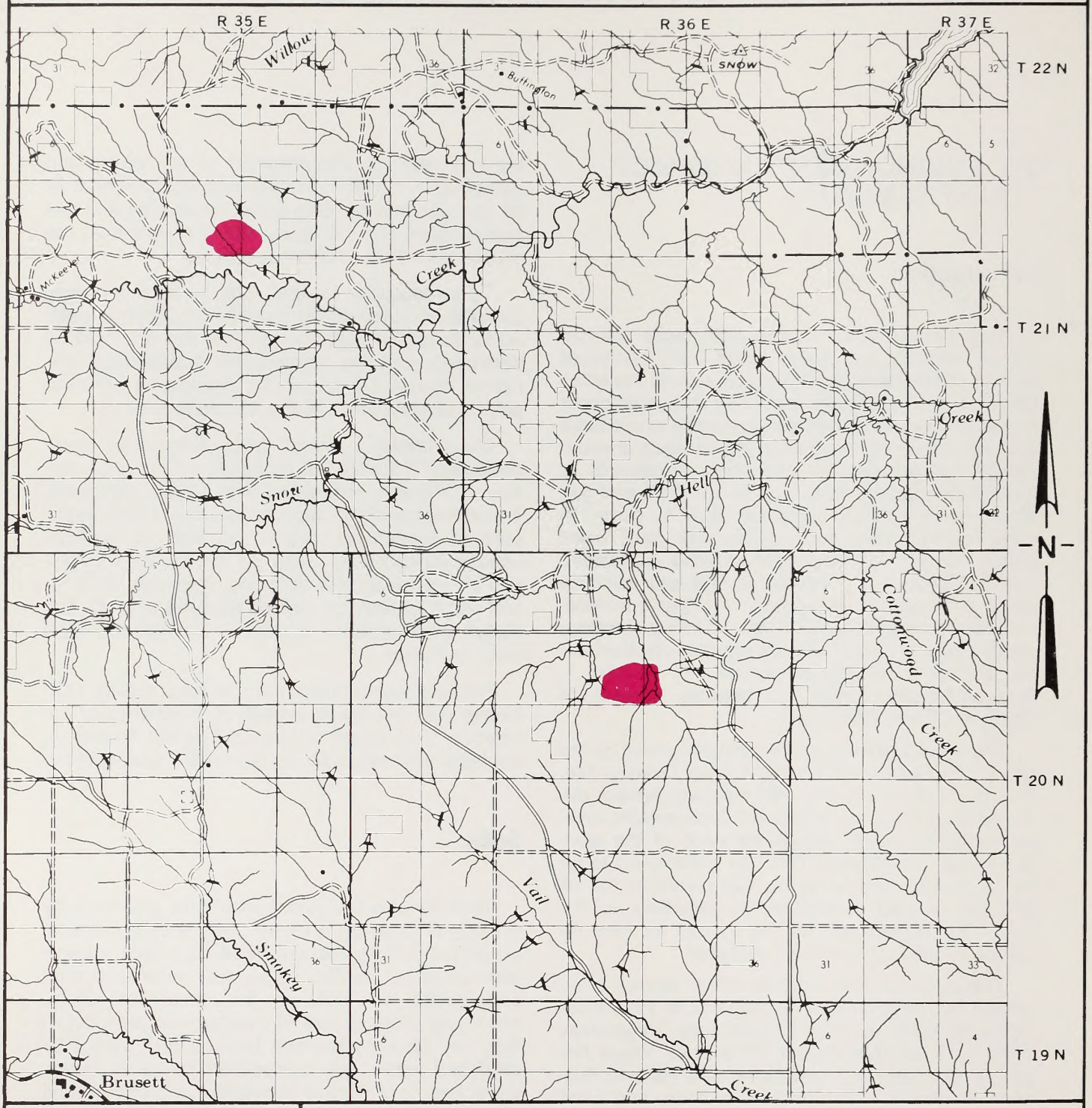
Soils

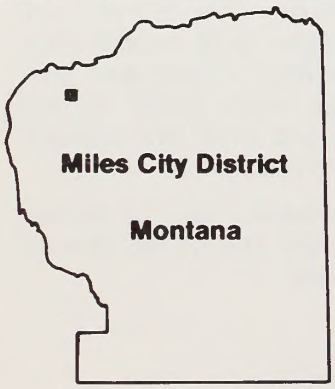
Soils in affected areas would be disturbed by virtually all phases of oil and gas activity. Impacts would result from the simultaneous effects of erosion (including rainfall, slope, and vegetation considerations), land use, use of construction equipment, and other factors. A reduction of soil productivity can be expected due to erosion of topsoil by wind and water, soil compaction by heavy equipment, loss of protective vegetation, and from mixing of soil horizons. Contamination of soils from fuel, crude oil, drilling fluids, and inferior fill materials is a possibility in the course of most oil and gas operations. Soils under storage tanks, roads, parking lots, holding basins, pads, and other land-consuming projects would be lost to production.

The following is an overview of the various stages of oil and gas activity and of the impacts that can be expected on soils.

FIGURE 2—2

PALEONTOLOGICAL SITES





LEGEND

Critically Sensitive Site

1 0 1 2 3 4 5 6

Scale In Miles

SOURCE: Miles City District Unit Resource Analysis, 1979.

Exploration and Exploratory Drilling Phases

The most prevalent impacts on soils in these phases of activity are compaction and destruction of soils and vegetation by vehicles, road building, and other related activities. Sometimes the use of unimproved roads and trails causes headcutting, water erosion, and compaction problems.

Compaction is a serious soil impact whenever it occurs because of reduced vegetation production and increased erosion. The measure of compaction is "bulk density" which is the ratio of voids to solids. It occurs when a compressing weight at the surface causes spaces in the soil to collapse; the soil then becomes more dense. This often occurs when a subsurface layer is saturated with water after a rain or snowmelt at the same time that the soil surface appears dry. Once this layer is compacted, a return to normal may require many years or may never occur on some soils depending upon soil types and local environmental factors. Compaction of soils by vehicles and heavy equipment severely limits or eliminates root and vegetation production. Old trails and access roads which have not been traveled for years often show little or no vegetation growing in the tracks due to the effects of a compacted layer in the subsoil combined with a loss of topsoil.

Preliminary exploration for oil and gas involves hundreds of miles of roads for seismic and drilling operations that can cause compaction of a relatively minor extent on several hundred acres annually. The amount of compaction and the resulting impact will vary greatly with the soil type and moisture content involved. The impact will be most severe when the soils have been saturated and are in the process of drying out. This situation occurs most frequently during spring and early summer. It is least likely to occur during winter and fall.

Sensitive and Critically Sensitive classes of soils (discussed below) are most susceptible to compaction during early spring and late winter thaws. On most soils, compaction will result in a decreased infiltration rate and increased runoff which will result in accelerated downslope erosion possibly creating rill and gully erosion.

Exploratory drilling may result in dust, rock chips, cuttings and toxic chemicals being brought to the surface and deposited near the drill hole. In preliminary drilling, toxic chemicals will be somewhat less prevalent than during the development and production phases.

During exploration, limited road building would occur to gain access to prospective oil and gas sites. Impacts from this type of road building will depend upon topography, time of year, and the duration of drilling activities. Impacts from turnouts, stream crossings, cuts and fills as well as road widths will depend upon topography and hydrologic features in the exploration area.

Soil disturbance may affect adjacent areas. Erosion by wind and water is a serious problem on many of the soils of the district. This erosion problem is increased when the areas are further disturbed by the construction of seismic roads, access roads, and drill pads. Such areas are more susceptible to erosion because of the increased volume of detached soil particles, such as in topsoil stock piles, which are easily moved by wind or water. These areas are characterized by soils with thin existing topsoil layers that provide a shallow mantle of protection.

The erosion potential of any soil increases with slope and/or with a decrease of vegetation. Soils which show symptoms of accelerated erosion, such as rills and large areas of sheet erosion, would be most seriously impacted by any soil disturbing activities.

Development and Production Phases

Impacts on soils during these two phases will be comparable to those described in the previous phases, but on a larger scale.

Fluids brought to the surface may contain fresh, brackish or saline waters containing chlorides, carbonates and sulfates. These chemicals may act as soil sterilants, breaking down soil bacteria processes and interactions. Toxic materials may remain several years until finally being broken down or leached to substrata. In most cases these materials are disposed of or buried.

Slope contributes significantly to erosion potential and revegetation problems (Table 2-1). Clearing and leveling of drilling pads would increase erosion over a 1/2 to 4 acre area. Reserve and waste pits may be built nearby to contain drilling muds and formation fluids. Such construction activities could affect slope stability in steeper areas. Additional slope failure and slumping could be induced by saturation from fluids or overloading by heavy equipment.

Oil spills, although not commonplace, do occur from time to time. Oil seepage may occur into pits, berms and in extreme cases, into gullies and low areas around wells (Figure 2-3). Permeable soils will be most affected by oil spillage because coarse and moderately coarse textured soils allow the deepest penetration into the substrata. The rate at which oil enters soils is usually slower than water. Oil thickness, composition and chemical makeup are all variable factors from well to well and affect the rate of absorption into different soil textures. Oil

TABLE 2-1

GENERAL SLOPE LIMITATIONS ON OIL AND GAS CONSTRUCTION PROJECTS[1/]

Common Slopes	Erosion Hazard	Revegetation
Level (0-4%)	Slight	Successful
Less than 15%	Moderate	Very Good
15-25% [2/]	Moderate to Severe	Fair to Good
Greater than 25%	Moderate to Critical	Fair to Poor

1/ Roads, pad construction, ponds, etc.

2/ Most slopes greater than 15% without established vegetative cover will erode at a greater rate than that at which the soil is produced through the soil forming process.

SOURCE: Miles City District, BLM; and Surface Operating Standards for Oil and Gas Exploration and Development, Second Edition, 8/78.



Figure 2-3

Oil Spill on Nonsensitive Soils - Oil Will Readily Break Down With Tilling

SOURCE: Miles City District, BLM

spills in active streams may be carried downstream (Figure 2-4), affecting soils along the way. Small stockponds and reservoirs are often near well sites in the district and, in some cases, could be in danger of contamination by oil spills.

Fugitive dust from roads, construction areas, drill pads, pits, etc., would become most severe during development and production, possibly reducing nearby vegetative growth and site rehabilitation potential.

Abandonment Phase

Activities involved with salvaging buildings, drill pad equipment, other oil field equipment and improvements would cause reoccurrence of impacts as described for the construction phase. Replacement soil material would likely be less productive than the original soil. New borrow areas may be required to meet these site rehabilitation needs.

Soils in the district are divided into four sensitivity groups: Nonsensitive, Sensitive, Critically Sensitive, and Requires Further Study (Figure 2-5). These groups are described below in more detail. In general, soil associations in the district are varied and complex, and it is difficult to distinguish site specific areas of environmental concern at the map scale required for this Assessment. Tables 2-2 and 2-3 and Figure 2-6 present soil sensitivity ratings for the Miles City District.

Nonsensitive - Nonsensitive soils may include soils that, under proper management, have moderate limitations and require moderate conservation practices. These soils are normally good for reclamation, have slopes less than 4%.

Sensitive - Sensitive soils may include soils that, under proper management, have severe limitations and require very careful conservation practices. These soils are fair for reclamation, and have slopes less than 15%. (Figure 2-7)

Critically Sensitive - Critically Sensitive soils may include soils that, under proper management, have very severe limitations that can make reclamation difficult. These soils are fair to poor reclamation potential according to Soils Conservation Service surveys (Figure 2-8).

Requires Further Study - Soils which need further study consist of those in counties of eastern Montana and western South Dakota that do not have detailed soil survey information. As a general rule, soil associations with steep slopes, poor development, high salt content, and high erosion hazard should be avoided where possible.



Figure 2-4
Potential for Soils and Surface Water Contamination from Reserve Pit Failure
SOURCE: Miles City District, BLM



Figure 2-5

Soils Sensitivity Categories: Nonsensitive Soils (left background), Sensitive Soils (right foreground), and Critically Sensitive Soils (left foreground and right background)

SOURCE: Miles City District, BLM

TABLE 2-2

SOIL SENSITIVITY RATINGS

Sensitivity Rating	Montana Soil Series	South Dakota Soil Series
A) NON-SENSITIVE These soils have less than a 4% slope, are productive and easily revegetated. Management problems are minimal.	Cherry, Cushman, Fort Collins, Havre, Wanetta and others.	Anselmo, Belfield, Ekalaka, Kieth, Kyle, Nunn, Bevar, and others.
B) SENSITIVE These soils have slopes less than 15%, have management problems, shallow topsoils or some erosion problems.	Bainville, Chama, Flasher, Magginnis, Pierre, Sprole, Tullock and others.	Absher, Canyon, Colby, Epping, Kakoka, Midway, Millboro, Opal, Pierre, Reeder, Reliance, Spearfish, Valentine, and others.
C) CRITICALLY SENSITIVE These soils have serious management problems, including fair to poor reclamation potential.	Badlands, Duncom, Flasher, Lismas, Midway, Promise, Bentonite formations and others.	Badlands, Boyd, Cabba, Cabbart, Lismas, Promise, Wayden, Bentonite formations and others.
D) REQUIRES FURTHER STUDY Currently detailed soil surveys have not been completed on the following counties, with no series being identified.	Prairie, Fallon, Carter, Rosebud, Garfield, Custer	Harding, Corson, Ziebach, Haakon, Jackson, Pennington, Custer, Fall River, Jones, Lyman, Gregory

SOURCE: Miles City District, BLM.

TABLE 2-3

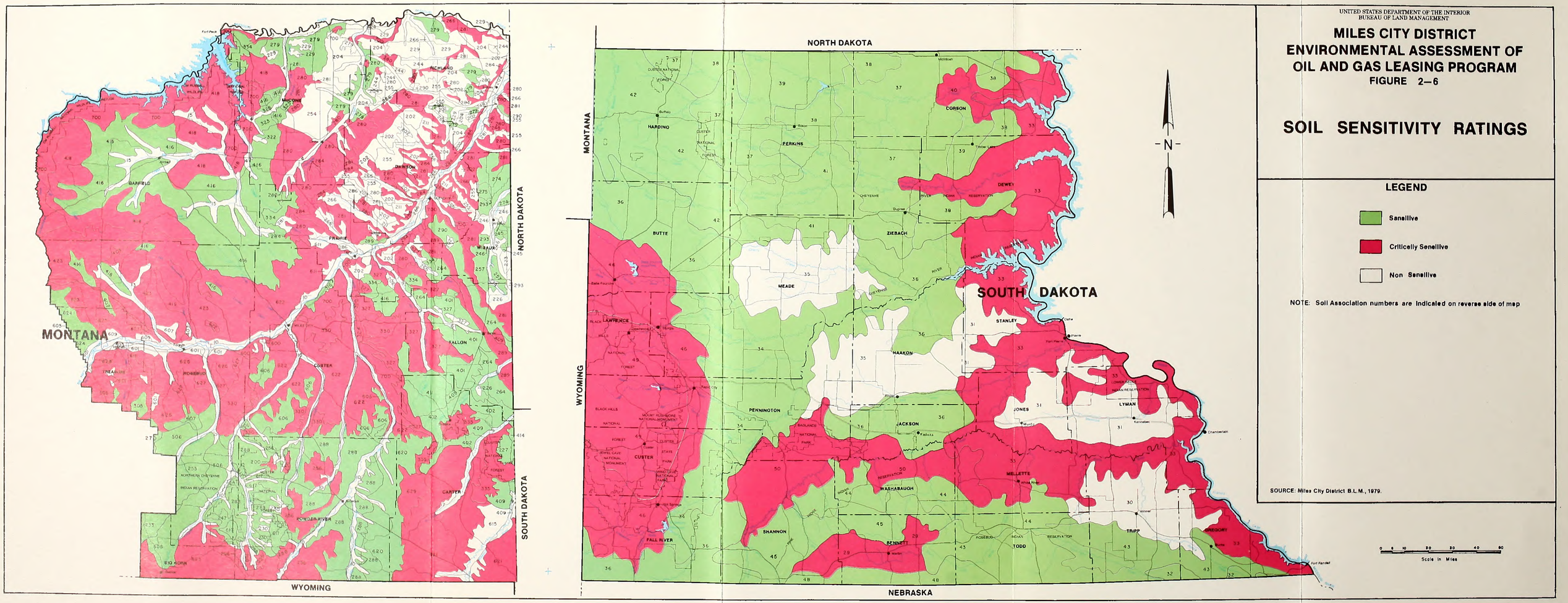
SUMMARY OF SOIL SENSITIVITY CLASSES

Sensitivity Class	MONTANA PORTION OF STUDY AREA			SOUTH DAKOTA PORTION OF STUDY AREA		
	%[1]	Public Surface[1]	Total Surface[1]	%[1]	Public Surface[1]	Total Surface[1]
Non-Sensitive	32%	893,344	6,262,912	14%	35,664	3,699,231
Sensitive	25%	697,925	4,893,650	55%	140,109	14,532,694
Critically Sensitive	42%	1,172,514	8,220,072	31%	78,971	8,191,154
TOTALS		2,791,700	19,571,600		254,744	26,423,080

1/ Assumes random distribution of soils regardless of ownership.

Acreages are estimates only.

SOURCE: Miles City District, BLM.



UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

MILES CITY DISTRICT ENVIRONMENTAL ASSESSMENT OF OIL AND GAS LEASING PROGRAM

FIGURE 2–6

SOIL SENSITIVITY RATINGS

LEGEND

- Sensitive
- Critically Sensitive
- Non Sensitive

NOTE: Soil Association numbers are indicated on reverse side of map

SOURCE: Miles City District B.L.M., 1979.



Figure 2-7

Poor Drill Site Location on Sensitive Soils. Note Nonsensitive Soils in Immediate Background.

SOURCE: Miles City District, BLM



Figure 2-8

Critically Sensitive Soils - Poor Rehabilitation Potential

SOURCE: Miles City District, BLM

Impacts of Bentonite Formations

Occasionally oil and gas activities occur on bentonite formations or deposits. Since not all bentonites have the same yield values, water holding capacities, and bonding strengths, each deposit must be considered separately with an on-site investigation. Basically, bentonites are difficult to revegetate due to their high sodium and magnesium content. The pH of bentonites (pH of over 7.0) are basic in nature. Bentonites corrode uncoated steel pipes while corrosiveness to concrete is relatively low. Often bentonites can be mixed with Portland cement for special purpose construction activities.

Shrink-swell properties make bentonite soils practically unmanageable for pipelines and road building. It has a high shrink-swell potential and can exert great lateral and vertical pressures with moisture changes. Damage to underground structures might result if offsetting design features are not employed.

Topography

All Phases

Topographic impacts from oil and gas activities would be minor. Impacts would occur mainly during the development stage and would be primarily visual in nature. Drilling pads, roads, pipelines and other construction activities would disrupt the natural landscape to some extent, depending upon location.

On steeper slopes, grading and leveling would extensively change small areas. Abandonment of pads, roads and other topographical changes can be considered to be permanent. Restoration of disturbed areas may not return the topography to its original condition. In most cases, a more gentle slope would result.

Vegetation

The direct destruction of plant cover by the construction of seismograph trails, drainage crossings, drill pads, roads, pipelines, and other facilities would be the major impact on vegetation. The degree of vegetation destruction from oil and gas activities varies with topography, climate, soils, and vegetation complexes. Rangeland types exhibit varying sensitivity and react accordingly to surface disturbance. The association of geographic areas with rangeland types is a method which identifies predominant vegetation and other similar characteristics such as climate, soils, and topography.

The impacts associated with each of the five phases of onshore oil and gas activity are discussed below.

Preliminary Exploration

Preliminary exploration would have moderate vegetative impacts. This activity involves seismograph trails and drainage crossings which, depending upon terrain and existing trails, may require bulldozer work. Destruction or disturbance to vegetation would be caused by crushing of forbs and grasses, and breaking or uprooting of shrubs or trees. The loss of vegetation from soil erosion, soil compaction, and siltation caused by truck-mounted equipment has not been quantified. Utilization of a water drilling system is subject to spillage and improper disposal of drilling mud which can destroy vegetation. Air quality is reduced in the immediate area from dust along roads, trails, and around drill sites if pneumatic drilling units are used. This could reduce vegetative growth rates. Systems failure of explosives or accidental fire is a possibility resulting in destruction of vegetation and increased soil erosion.

Exploratory Drilling

Exploratory drilling can have a high impact on vegetation. Temporary roads and drilling pads require the complete removal of vegetation. On Sensitive and Critically Sensitive rangeland types, design and location are extremely important to minimize destruction of high value vegetation. The impact of vegetation removal on other components can be serious, depending upon the area and the component(s) being considered. Other possible impacts include the spillage of toxic materials used in drilling or toxic fumes, primarily hydrogen sulfide, encountered in the drilling process. The loss or disposal of toxic material around perimeters of drill pads could damage vegetation. The same problems could occur, to a much greater extent, when pits or reservoirs fail because of faulty design or construction.

Development

Development of oil and gas lease areas into active fields has a high impact on vegetation. Permanent roads include, at a minimum, one main route to serve the lease area with one access road to each well. This usually involves widening and upgrading temporary roads for all-weather use.

Drill pads are not completely rehabilitated in the short-run if the well is successful. Instead, storage tanks, separators, pumping equipment, and a power source are installed on the drilling site. Often the perimeter of the drilling site, not required for the continued operation of the well, can be restored as nearly as practical to its original condition. Construction of buried pipelines for transporting oil or gas from well or fields to distribution points or initial treater facilities results in destruction of some vegetation. To accommodate facility construction activity, a line is cleared along a secured right-of-way for installation and maintenance. Reseeding after construction along rights-of-way is not always successful, especially with the more sensitive soil and vegetative types. The amount of precipitation is an important variable in these situations. The resulting disturbed area may be of low productivity or may produce undesirable vegetation. This activity involves additional specialized equipment and manpower which increases the amount of travel to the area. This can affect air quality and vegetative productivity. Short-term increases in dust would occur. Other impacts to the area would be toxic fumes, spillage of toxic materials, burying of waste pits, oil spills, and leakage from flow lines. Accidental fire is always of concern.

Production

Production of oil and gas wells or fields has a relatively moderate impact upon vegetation because the disturbance to vegetation in terms of habitat lost or vegetation out of production would have already occurred during the development phase. Recurring oil field maintenance can affect areas that have undergone rehabilitation efforts, causing renewed damage. The flaring of hydrogen sulfide could damage some vegetation; however, documented evidence of this happening has not been recorded. Vegetative damage would be minimal in most cases. Production water can contain concentrations of salts which are higher than the natural waters and could, over a long period, cause loss of desirable vegetative production due to salt concentration in the soil.

Abandonment

Abandonment and rehabilitation of oil and gas fields has a moderate impact on vegetation. The facilities can be removed and most of the area reclaimed. These areas are usually artificially revegetated using the stockpiled topsoil provided for in the reclamation plan. Roadways, pads, or platforms, sometimes remain, depending upon the type of fill material. Recreational benefits may preclude total rehabilitation of access roads into such an area.

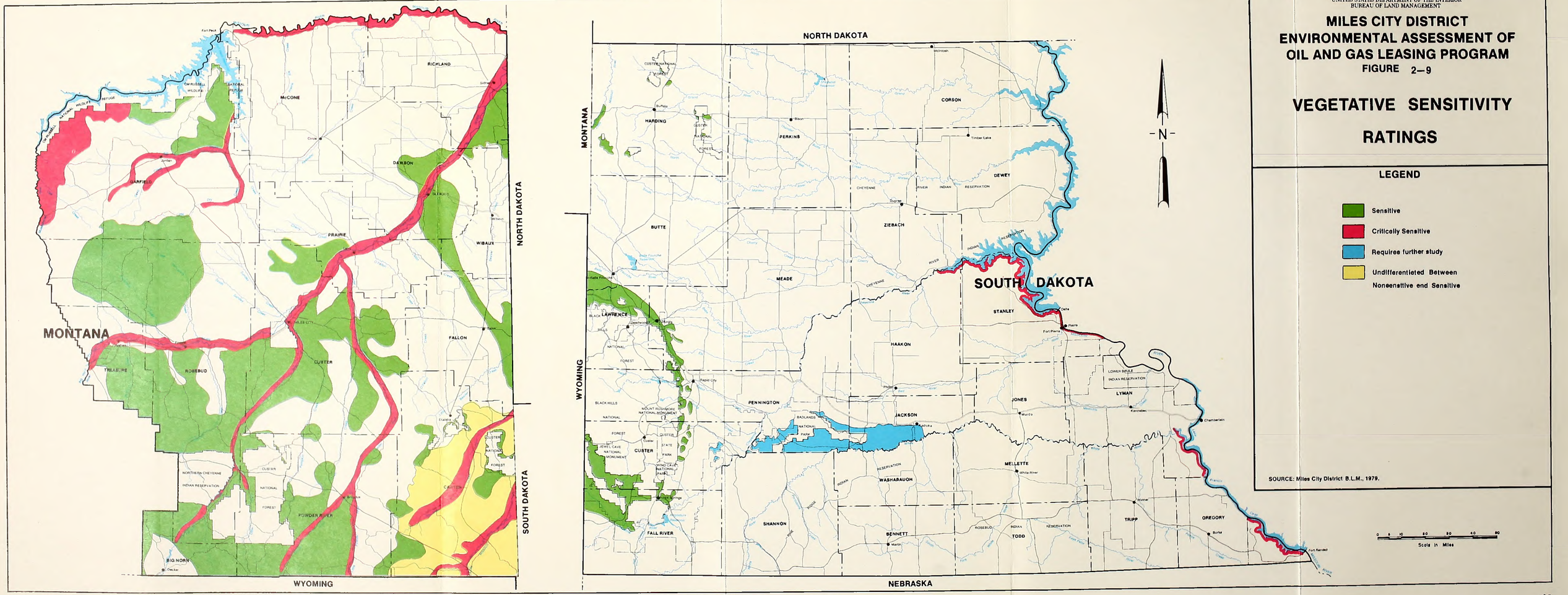
The impact analysis developed for vegetation considers steep slopes, fragile soils, vegetation density, erosion problems, and long-term rehabilitation problems. All of the broad vegetative types described in Chapter 4, Affected Environment (see Figure 4-11) have been analyzed for sensitivity relative to oil and gas activities. The sensitivity ratings shown in Figure 2-9 and described in Table 2-4 do not apply throughout the entire vegetative type; however, they do characterize the primary vegetative type within each area. Additional vegetative information can be acquired from range site descriptions, provided such classifications can be delineated from the soil data.

Critically Sensitive types comprise about 11 percent of the Montana portion of the study area and 1 percent of the study area in South Dakota. Sensitive types comprise about 25 percent of the study area in Montana and 6 percent in South Dakota. The remainder in both areas would be Nonsensitive or Requires Further Study.

Topography, climate, and ecological sites vary within, for example, the grasslands designation thus affecting vegetation types and sub-types. The capability of a Nonsensitive area to recover from disturbance through either natural or artificial reclamation is greater in comparison to the other vegetation types classified in this assessment. An area's climate, topography, soils, and vegetation, with the latter two being expanded into ecologial sites, was then applied to the remaining area to establish the impact sensitivity analysis. The process for categorizing sensitivity considers a range of differences among elements. Included are average temperature, precipitation, and length of growing season. There are topographical differences such as elevation, slope, and aspect; soil differences such as depth, texture, structure, slope, available nutrients, and parent materials; and vegetation differences such as grass, perennial forbs, shrubs, broadleaf trees, conifer, and barren land. The interplay between predominant vegetation types and landform denotes a relationship in the environment that would be affected by oil and gas activity. Consequently, the vegetative sensitivity classifications are based upon the likely effects of oil and gas activity on ecological interrelationships.

Water

The oil and gas industry has operated in the study area for many years, in some cases affecting the water resource and altering the quantity and quality of both surface and ground waters.



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FIGURE 2–9

VEGETATIVE SENSITIVITY RATINGS

LEGEND

- Sensitive
- Critically Sensitive
- Requires further study
- Undifferentiated Between Nonsensitive and Sensitive

SOURCE: Miles City District B.L.M., 1979.

TABLE 2-4

SUMMARY OF BROAD VEGETATIVE TYPE SENSITIVITY RATINGS

Sensitivity Rating	MONTANA Type No.	MONTANA Name	SOUTH DAKOTA Type No.	SOUTH DAKOTA Name
Nonsensitive	12	Central Grasslands	3	Wheatgrass-Needlegrass
	15	Prairie County Grassland	4	Wheatgrass
	18	Northeastern Grassland	5	Wheatgrass-Gramagrass
	20	Southeastern Grassland	7	Sagebrush-Grass
	22	Sandy Grassland		
Sensitive	13	Eastern Montana Ponderosa	8	Pine-Savannah
	14	Sagebrush-Saltbush		
	17	Ponderosa Pine Savannah		
	19	Badlands Grasslands		
Critically Sensitive	11	Missouri Breaks Scrub Pine	9	Black Hills Pine Forest
	21	Undifferentiated Stream and Lake Bottoms		
Requires Further Study			6	Wheatgrass-Gramagrass-Buffalograss (Badlands)

SOURCE: Miles City District, BLM.

This section presents the impacts on the water resource associated with leasing under the present regulations.

The following impacts are not identified by exact legal or geographic locations. Rather, they are identified in geomorphic terms such as stream channel areas, steep sloped areas, and floodplain areas because there are no site-specific hydrologic data covering the Miles City District. Also, it is impossible to forecast specific locations of future oil and gas development which may result in hydrologic impacts.

The figures in this section outline the general areas that are considered to be Sensitive and Critically Sensitive with respect to water resources. The Map Overlay File presents areas of hydrologic concern in greater detail.

Preliminary Exploration Phase

Erosion and Sediment Yield

During the preliminary exploration phases, several types of on-the-ground seismograph surveys are made. New access trails are required for the movement of heavy equipment. Cooperation between the BLM and seismograph companies concerning the placement of access trails and the amount of bulldozer work reduces the amount of erosion and sediment yield from seismograph trails. The amount of damage that occurs depends upon the type of soil, vegetative cover, and slope at each site. The Soils section addresses soil series-specific erosion potentials resulting from oil and gas leasing.

The most severe problems to the water resource typically occur where trails cross stream channels. If earthmoving work is needed, the disturbed area may yield large volumes of sediment to the stream channel. This work generally occurs in ephemeral and intermittent stream channels; with runoff these sediments can be transported to perennial waters.

Sediment transported by streams increases turbidity, alters the stream channel characteristics, and adversely affects the municipal, agricultural, and industrial uses of water. Data are not available to quantify the extent of this impact.

Ground Water Quality

The detonation of explosives for seismograph exploration can seriously affect shallow ground water wells and springs if this work occurs too close to these water sources (e.g. less than 1/8 mile). The shock from such explosions may alter the aquifer and significantly reduce or change water yields in both wells and springs; water quality in wells and springs can also be altered.

Exploratory Drilling Phase

Erosion and Sediment Yield

The drilling of exploratory wells requires roads which are of a more permanent nature than seismograph trails. These roads are completely stripped of vegetation and at times may be graveled to permit year-round access. Drilling pads from one-half to one acre in size are also constructed.

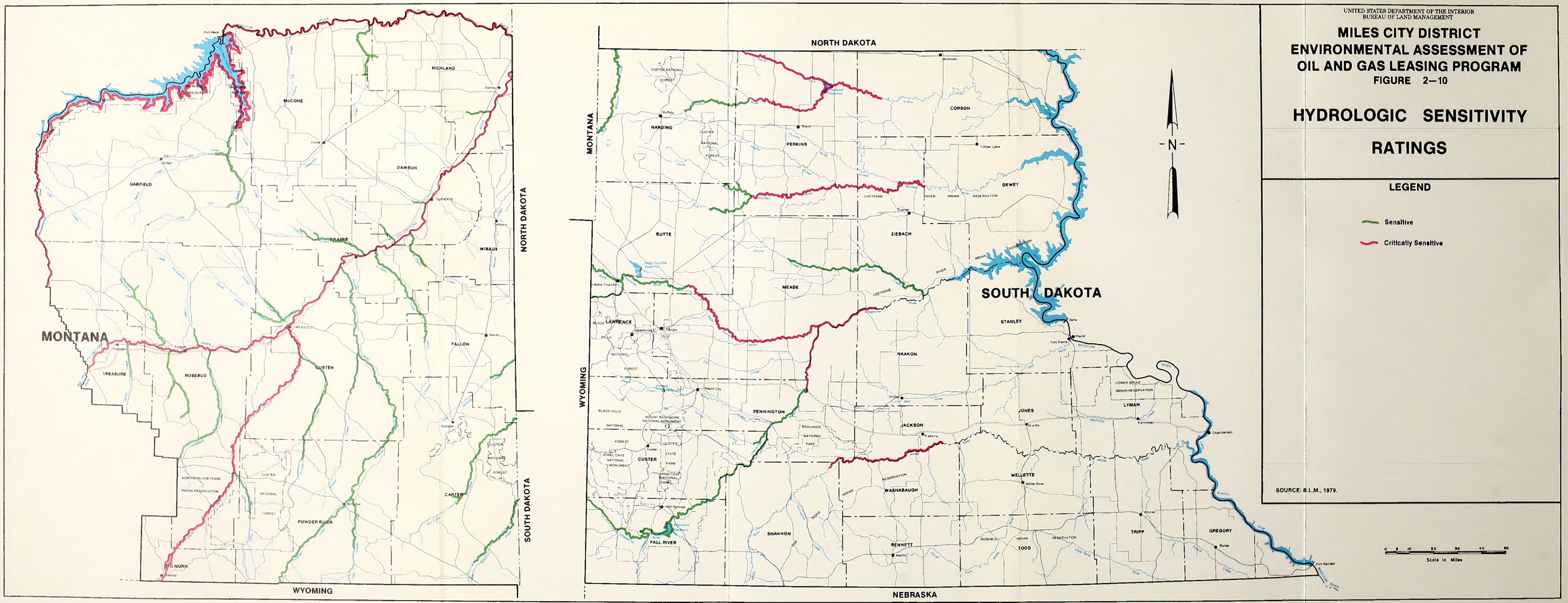
Culverts are usually placed at all major drainage crossings. Occasionally, the culverts are not large enough to handle peak runoff and the crossing washes out, depositing sediment into the stream channel. Crossings are generally on ephemeral or intermittent drainages and do not have an immediate serious impact to the water resource.

Access roads and drill pads are subject to erosion. Floodplain areas are of more critical concern in terms of the amount of sediment yielded to streams. Oil and gas development in these areas could have an immediate effect on the turbidity, suspended sediment concentration and bedload of a stream. Ultimately this can impact a variety of water uses. Figure 2-10 identifies floodplain areas of particular concern. These floodplains are divided into Sensitive and Critically Sensitive areas.

Ground Water Quality

When mud pits are used at the drilling site, there is a chance of contamination of nearby ground water sources. The majority of wells which are drilled are far above the water table and present no problems. If wells are drilled on alluvial floodplains which are aquifers, the mud pit fluids may percolate down into the ground water creating local contamination. A single oil well in an area could present only a minor problem. Several wells, however, could cause a significant problem by impairing the uses of ground water or adjacent surface waters. Figure 2-10 also identifies those areas where ground water contamination is possible.

In addition to contamination from mud pits, the well itself can lead to interformational mixing of waters and degradation of ground water quality. Present regulations including the requirement of cementing the well casing substantially reduces the chances of this occurring and it is not believed to have created any problems in the Miles City District.



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FIGURE 2–10

HYDROLOGIC SENSITIVITY RATINGS

LEGEND

- Sensitive
- Critically Sensitive

SOURCE: B.L.M., 1979.

Scale in Miles

Development Phase

Erosion and Sediment Yield

The installation of pipelines, tank batteries, and permanent access roads increases erosion and sediment production. The degree of impacts concerning erosion and sediment yield is area-specific and is discussed in more detail in the Soils section.

Production Phase

Ground Water Quality

The water that is separated during the oil production phase is sometimes reinjected into the ground. Regulations state that reinjected water must be introduced into a subsurface horizon containing water of equal or poorer quality. In many cases, it is reinjected into the producing zone from which it came. Although there is a chance, through accident, of temporarily reinjecting water into a fresh water zone, it is unlikely and not known to have occurred in the study area.

Surface Water Quality

The most severe hydrologic impacts associated with the production phase would occur from an oil spill. Oil spills generally occur when the petroleum is in transit, but may also occur during exploratory drilling, development, or production. All oil spills are reported to the Environmental Protection Agency and the State Department of Health and Environmental Sciences. These agencies are resposible for investigating oil spills.

An oil spill entering a live water body could have a significant and long-lasting effect. The oil might render the water unsuitable for domestic, wildlife, livestock, agricultural, and industrial uses. The impact from a spill, if unchecked, could extend for miles throughout many drainages.

It is not feasible to analyze the probability of spills occurring at specific sites. In general however, any oil field development along perennial streams has the greatest chance of creating a significant impact to the water resource. If an oil field is situated within the floodplain, flooding could contaminate surface waters.

In most cases, produced water is allowed to evaporate or is trucked to disposal wells. Any water which is discharged is monitored regularly and must meet certain water quality standards. Discharge of produced oil field waters is regulated by the Environmental Protection Agency in South Dakota and the Department of Health and Environmental Sciences in Montana. Very little water is discharged into natural drainages; consequently, impacts from discharge would be minor.

Abandonment Phase

Erosion and Sediment Yield

The removal of tank batteries, pipeline, etc., during abandonment causes some additional surface disturbance. After revegetation, erosion and sediment yield will decline but continue until the site stabilizes and vegetation becomes well established. This process could take several years in the study area, depending upon the environmental characteristics of the site such as soil type and depth, precipitation, and slope, to mention a few.

Animals

Pad construction, road construction, and the human activity involved with oil and gas production would create the most significant impacts to animals from oil and gas activity in the Miles City District. Many of the effects upon wildlife would be indirect effects from the standpoint that a loss of vegetation (habitat) will result in a loss of forage for animals or a change in water quality will result in a change in the fish population. Other impacts will be direct in the sense that continued disturbance may result in abandonment of a sharptail dancing arena, for example.

Preliminary Exploration

At times, rudimentary road construction is often involved during this phase of oil and gas development, although dirt work is usually limited to drainage crossings. This activity causes a temporary loss of vegetation which results in less forage available for local animals. Furthermore, bulldozing activities or the weight of heavy vehicles on non-road terrain could destroy nest sites of birds or eliminate valuable habitat for species of limited mobility including prairie dog towns. These towns are the primary habitat of the endangered black-footed ferret.

The construction of roads and trails in previously inaccessible areas can create new routes for livestock to follow, resulting in a change in grazing patterns. This could result in a change in the vegetative composition of the area previously undisturbed by livestock, resulting in a change in wildlife use. Introductions of livestock to previously unused areas would increase competition with wildlife for forage, water, and space. Road construction and vehicle movement across creeks and streams would temporarily increase the turbidity of the water, and, if severe enough, could adversely affect the downstream aquatic fauna.

Many wildlife species are intolerant of increased human activity and the noises associated with the activity. This can be of extreme concern when it affects a critical period in the life cycle of the species (e.g., breeding season) or if critical habitat is affected during periods of wildlife use.

Similarly, continued activity on or near sharptail and sage grouse breeding arenas, when the birds are displaying, could result in temporary abandonment and disruption of breeding activity.

Exploratory Drilling

In this phase, intensive human activity could be very detrimental to wildlife. The continual use of roads by heavy trucks hauling drilling equipment, water, and work crews throughout this phase of activity would reduce animal use in the area. The likelihood of gates being left open increases with increased human activity. This would create problems for the ranch operators by allowing livestock to cross pastures or allotment boundaries. After the drill rig is constructed, this level of activity would continue anywhere from 2 days to several months, depending on the depth drilled and difficulty encountered. This activity normally averages less than 2 months in duration.

During this phase, blow-out is a potential system failure of major environmental concern. Drilling mud, oil, and salt water can be strewn over an acre or two. This would eliminate the wildlife habitat in the immediate vicinity of the affected area. If a blowout occurred near a drainage, toxic substances could enter the water and, if concentrated, would have adverse effects on the downstream aquatic fauna.

Abandonment of the area by wildlife would be likely if human activity occurred in the immediate vicinity of bald eagle nests, peregrine falcon nests, deer or antelope winter concentration areas, grouse dancing and strutting grounds, or waterfowl nesting areas during a critical stage of the species life.

Devegetation of the oil and gas lease area would be more extensive in the development stage than during the preliminary exploration stage. Extensive bulldozing to accommodate the drill pad site and heavy trucks which utilize the road would eliminate the habitats of some small mammals, reptiles, and amphibians directly under the area as well as eliminating the forage for other animals that use the surface. Further vegetation loss would occur in an area where rig skidding is practiced.

Drill site reserve pits contain materials toxic to wildlife (Figure 2-11). Typically, a pit remains in the area for four to five months. Animals have been observed attempting to use this water source at some sites. If not adequately protected, both domestic and native animals may attempt to use that water, especially on drier range sites. When the drilling is completed, approximately 15 semi-trailer trucks are required to move the rig and other equipment out of the area. This requires further expansion of the drill pad, eliminating more vegetation and habitat around the site. Sometimes water instead of oil is extracted during drilling. These wells, if developed, can provide an important water source for livestock in some areas.

When conditions are wet and muddy at a drill site, the primary access road can become badly rutted from heavy truck use, making it virtually impassible. Oil rig crews are then forced to drive off the road to get to and from the site, resulting in further devegetation in the area and less forage available for wildlife.

Development

During the development phase, human activity intensifies over the entire field as more drilling occurs to establish the oil field boundaries and pipeline is laid from one producing site to the next.

An often haphazard road maze is developed throughout the field. Field development would have effects on the animals of the area similar to the exploratory drilling stage, but on a greatly expanded basis. The magnitude of the increase is dependent upon the size of the oil or gas field. Most established fields range in size from less than 1,000 acres to several thousand, although a few (Bell Creek, Cedar Creek) cover several townships.

Production

The production stage of oil and gas development would probably have the most severe impacts on wildlife due to the longevity of the phase. Oil from producing wells is stored in tank batteries and transported by truck to refinery facilities prior to pipeline completion. Major potential impacts on wildlife would result if an oil truck overturned and oil escaped. This is an especially likely occurrence during icy or muddy conditions.

At this same time, there is a possibility of pipeline rupture between the well and the tank batteries. A rupture of this nature occurred in the Little Beaver Field in 1971 and an estimated 2,000 barrels of oil were lost in the Little Missouri drainage. If this occurred, oil would continue to spill until the operator inspects the site. This inspection usually occurs once per day. Vegetation would be destroyed by the oil and the drainages below the spill can become extremely contaminated. This could



Figure 2-11

Ducks Found in Reserve Pit

SOURCE: Montana Department of Fish, Wildlife, and Parks

severely affect the terrestrial and aquatic fauna utilizing the affected environment. In 1978, 20 pipeline breaks occurred in the state of Montana and in 11 of these, petroleum products reached state waters. However, cleanup measures utilizing hot water flushing and immediate skimmer techniques have proven successful if promptly employed.

Similarly salt water encountered during oil and gas drilling activity can be extremely harmful to the surrounding environment if a spill of this sort occurs.

During winter, heavy equipment is utilized to keep oil field roads passible for daily inspection by the field operator. The volume of traffic will be further increased by local residents and recreationists using those roads. The amount of human disturbance wildlife can withstand is variable among species. However, the amount of disturbance any one species will tolerate is lessened during critical stages of its life. Noise and vehicle movement in close proximity to bald eagle and peregrine falcon nesting areas, for example, could inhibit the animals' nesting success. Continual disturbance in deer or antelope winter range may cause the animals to abandon these crucial areas. Motion and noise near grouse breeding arenas could inhibit their breeding behavior and disturbances near duck nesting and breeding ponds would probably restrict their breeding behavior or nesting attempts. Excessive disturbance in a critical habitat of other species would have similar effects.

The extensive system of roads, drill pads, and ancillary facilities associated with a large scale oil and gas field would eliminate up to 10% of the land from forage production in a given field (see the Vegetation and Land Use sections). This would reduce forage for both livestock and wildlife, as well as escape and nesting cover for wildlife. This could result in some need for temporary reduction of grazing allocations. Roads and trails could, however, aid in improved livestock dispersal.

Abandonment

The abandonment phase of oil and gas activity results in positive effects for wildlife. The cessation of activity will allow those animals intolerant of the activity to return to a normal routine. Revegetation of the well sites and roads will increase the forage available to animals in the area.

The major problem that could, though not likely, occur during abandonment would be unsatisfactory reclamation. Normally, repeated attempts are made until the revegetation effort is successful. The operator's bond is released upon successful reclamation of the area. Salt water, oil spills, and hydrogen sulfide leaks could make revegetation in these areas difficult. Furthermore, if reseeding did not include the primary access roads, they would continue to be used by local residents and recreationists causing continued disturbance to wildlife.

The animal species in an area depend upon the vegetative type that is associated with the site. Thus, on an area-specific basis, one can reasonably predict those animals that stand to be affected if the vegetative type is known. (See Appendix 4-2 for animal species habitat associations.) Each of the five phases of oil and gas activity would have some effect on the animals that live in the vicinity. Several areas throughout the district have been identified as Critically Sensitive concerning wildlife. In these areas, destruction of necessary habitat and/or human disturbance associated with oil and gas activity during a critical period of the animals' life could have severe effects on those animals.

Because of the geographic scope of this assessment, it is not possible to map wildlife/habitat sensitivity ratings for the entire district in this document. For that reason, examples of Sensitive or Critically Sensitive wildlife areas within the district are presented instead. However, detailed wildlife sensitivity ratings for the district appear in the Oil and Gas Map Overlay File.

Areas designated as Sensitive and Critically Sensitive in the accompanying maps are, by no means, a complete list of these areas within the district. Areas where detailed wildlife inventories were conducted (Decker, Wibaux, Intake, etc.) have revealed a higher concentration of Critically Sensitive areas, especially grouse breeding arenas, than occur in the remainder of the study area. Consequently, portions of the study area have been classified as Requires Further Study in the Map Overlay File until more resource information becomes available.

Endangered species habitat is designated Critically Sensitive due to the limited habitat available for preservation of the species. This includes eagle nesting and wintering areas, and peregrine falcon eyries (Figure 2-12). Human disturbance at eyries can be a serious problem especially during nesting season; the falcon will usually abandon its nesting attempts when harassed. Some peregrines will refuse to breed if humans have been anywhere near their eyries. Historically known nesting cliffs and potential nesting areas are shown in the Map Overlay File. Black-footed ferrets have been most recently sighted in Carter County, Montana and Mellette and Bennett Counties, South Dakota (Figures 2-13 and 2-14). It is in the best interest of this endangered species not to give exact locations. For this reason, prairie dog towns in those counties have been conditionally designated as Critically Sensitive. The northern swift fox, listed as threat-

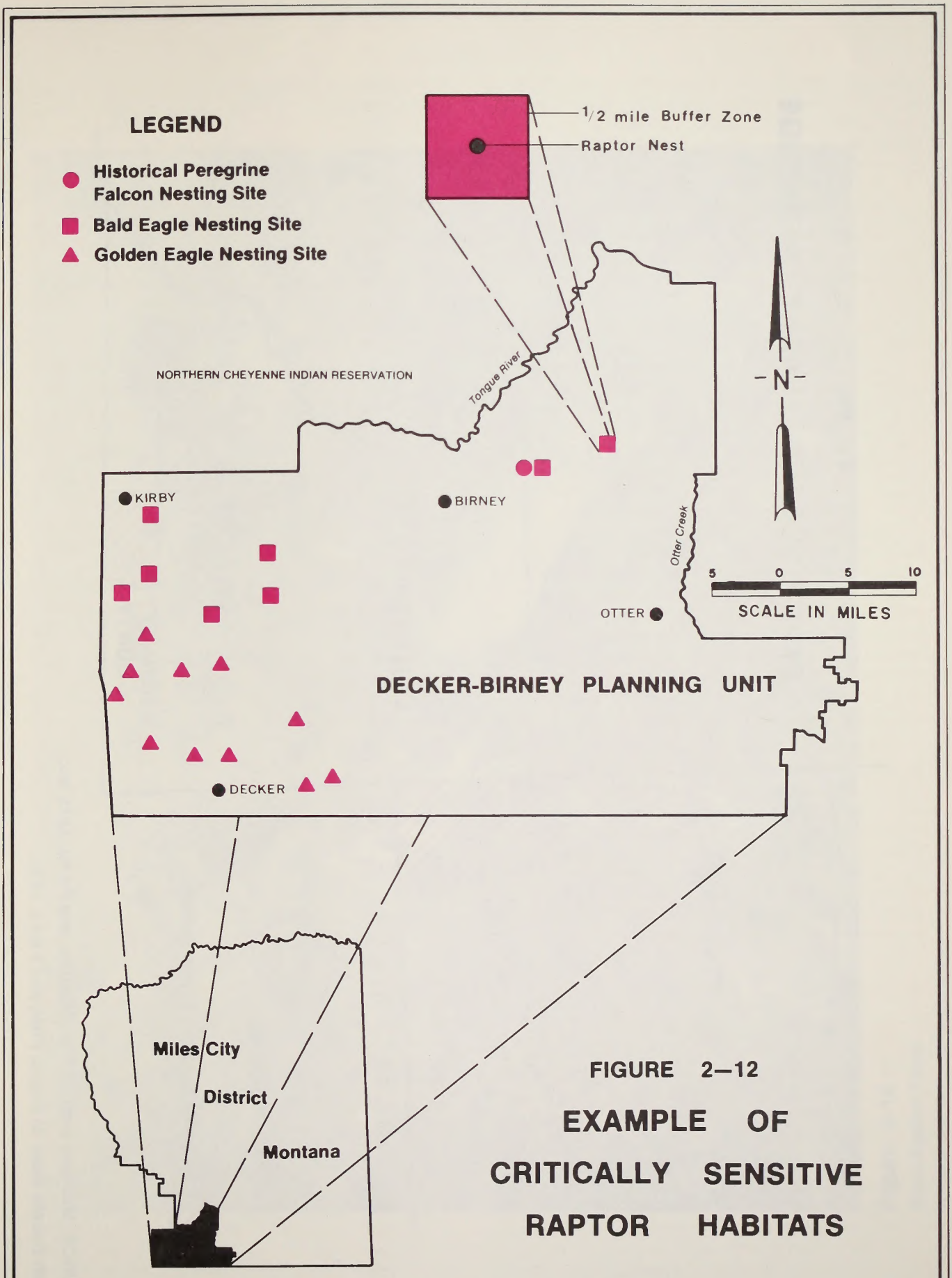


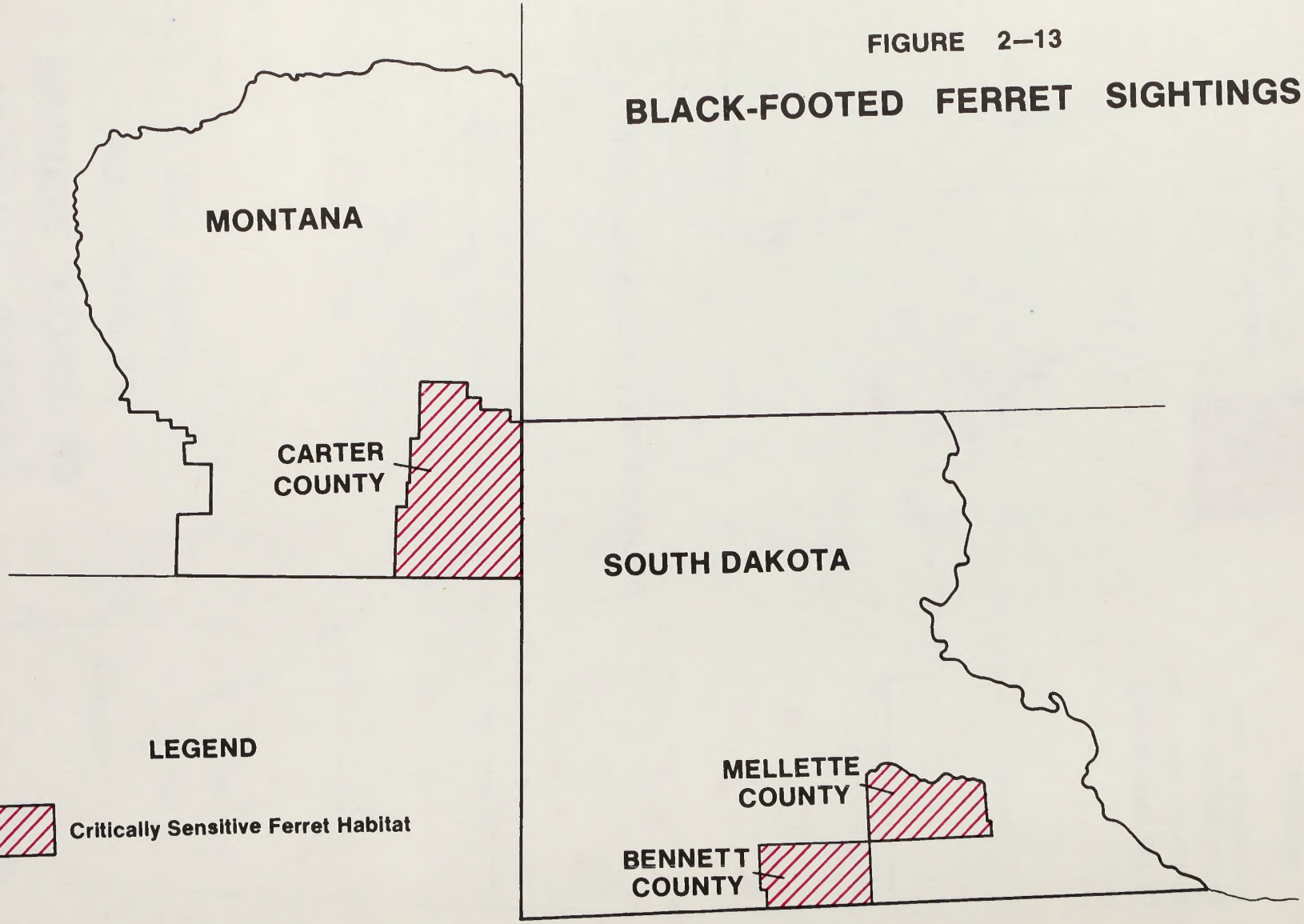
FIGURE 2—12

EXAMPLE OF CRITICALLY SENSITIVE RAPTOR HABITATS

SOURCE: Montana Dept. of Fish, Wildlife, and Parks, 1979

FIGURE 2—13

BLACK-FOOTED FERRET SIGHTINGS



SOURCE: Montana Dept. of Fish, Wildlife, and Parks, 1979 and South Dakota Dept. of Game, Fish, and Parks, 1979.



Figure 2-14
Black-Footed Ferret
SOURCE: U.S. Fish and Wildlife Service

ened in South Dakota, is also strongly associated with prairie dogs; the dogs represent an important food source. Consequently, prairie dog towns are highly important as potential habitat for some species of special concern.

General big game winter ranges have been designated Sensitive throughout the entire district. Big game winter concentration areas are considered Critically Sensitive since they represent limits of food and cover available for the animals during severe winter conditions. Figures 2-15 and 2-16 show mule deer and antelope sensitivity ratings within certain areas of the district.

Sharptail and sage grouse breeding arenas are considered Critically Sensitive because of their importance to reproduction and general survival of the local population. Figure 2-17 shows an example of clustered grouse breeding arenas (sharptails in this example) in a segment of prime habitat in the study area.

Bighorn sheep habitat is considered Critically Sensitive because of the unique limited habitat that exists in the district (Figure 2-18). Geist (1974) found that human disturbance caused sheep to vacate their accustomed areas. If disturbance occurred on wintering habitat, it could result in relocation of the local population, perhaps to an area in which their chances of survival are lower.

Riparian habitat in the Miles City District associated with major rivers and drainages is extremely valuable because no other vegetative community is as capable of supporting the variety of species or total number of animals. Important game species such as white-tailed deer and ring-necked pheasants are almost totally dependent on riparian vegetation for their year-round food and cover requirements. Furthermore, it provides seasonal habitat for nesting birds and wintering mule deer in some areas. Many furbearing mammals found in the study area are associated with major waterways and the surrounding vegetation. Similarly, wintering areas for bald eagles are found along major streams. Riparian areas (Figure 2-19) have been designated as Critically Sensitive because of the high density of animals found in these areas and the relatively limited amount of river habitat within the study area.

Recreation

Continuation of oil and gas activity in the Miles City District would cause only minor direct impacts on recreation within the region. However, there could be increased secondary impacts to some urban centers if population increased significantly. These impacts, to both urban and outdoor recreation, would occur in direct proportion to population increases associated with the five phases of oil and gas activity.

Preliminary Exploration and Exploratory Drilling

During preliminary exploration and exploratory drilling, a minor increase in population is expected. This increase is not expected to impact existing recreational patterns or facilities to any appreciable degree.

Development

During the development phase in a given area, a substantial increase in population could occur which may severely impact both indoor and outdoor recreation facilities. An increase in outdoor recreational use may reduce the perceived quality of the experience.

The construction of additional roads in areas of oil and gas activity would allow access into areas that are currently inaccessible to the average recreational user. This access could increase the amount of littering and off-road vehicle use in these areas. It could also provide better access to an increased number of hunters.

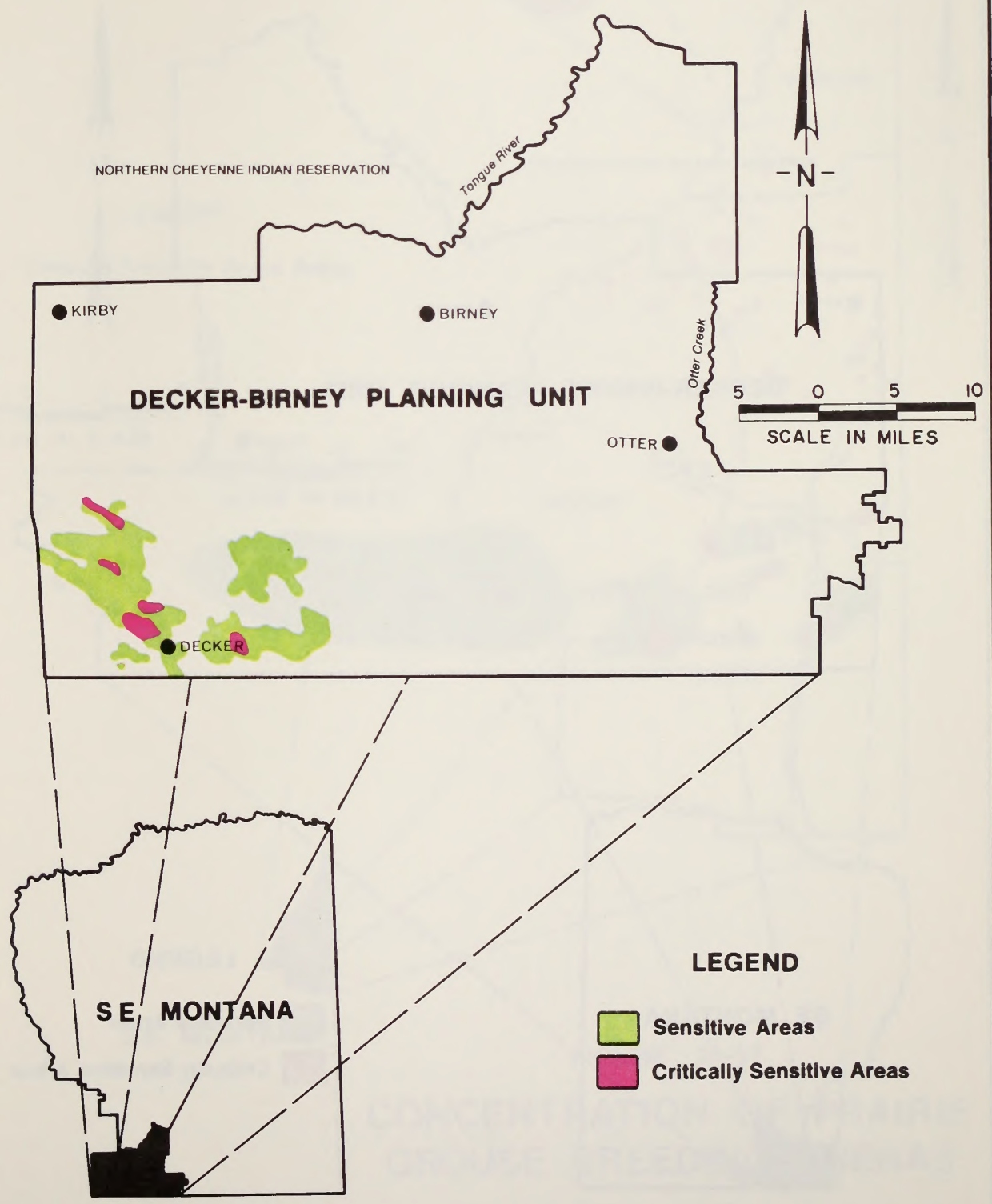
Based on available information, it appears that the only towns in the study area that could absorb a rapid increase in population of approximately 300 additional people without experiencing severe problems are Miles City and Glendive (see Economic and Social Conditions, Chapter 2, for population estimation methodology). These two towns are considered Nonsensitive to this level of population impacts. The remaining towns within the study area, based on existing facilities and relatively small populations, are considered Sensitive or Critically Sensitive to recreational impacts from an additional 300 people.

Production

During the production phase, it is anticipated that oil and gas related population would decrease in comparison to the development phase. This would help relieve pressure, relative to the development phase, on existing recreation facilities and hunting within the region, but would not eliminate it. Impacts to already overused areas by increased hunting pressure could be expected to continue.

FIGURE 2–15

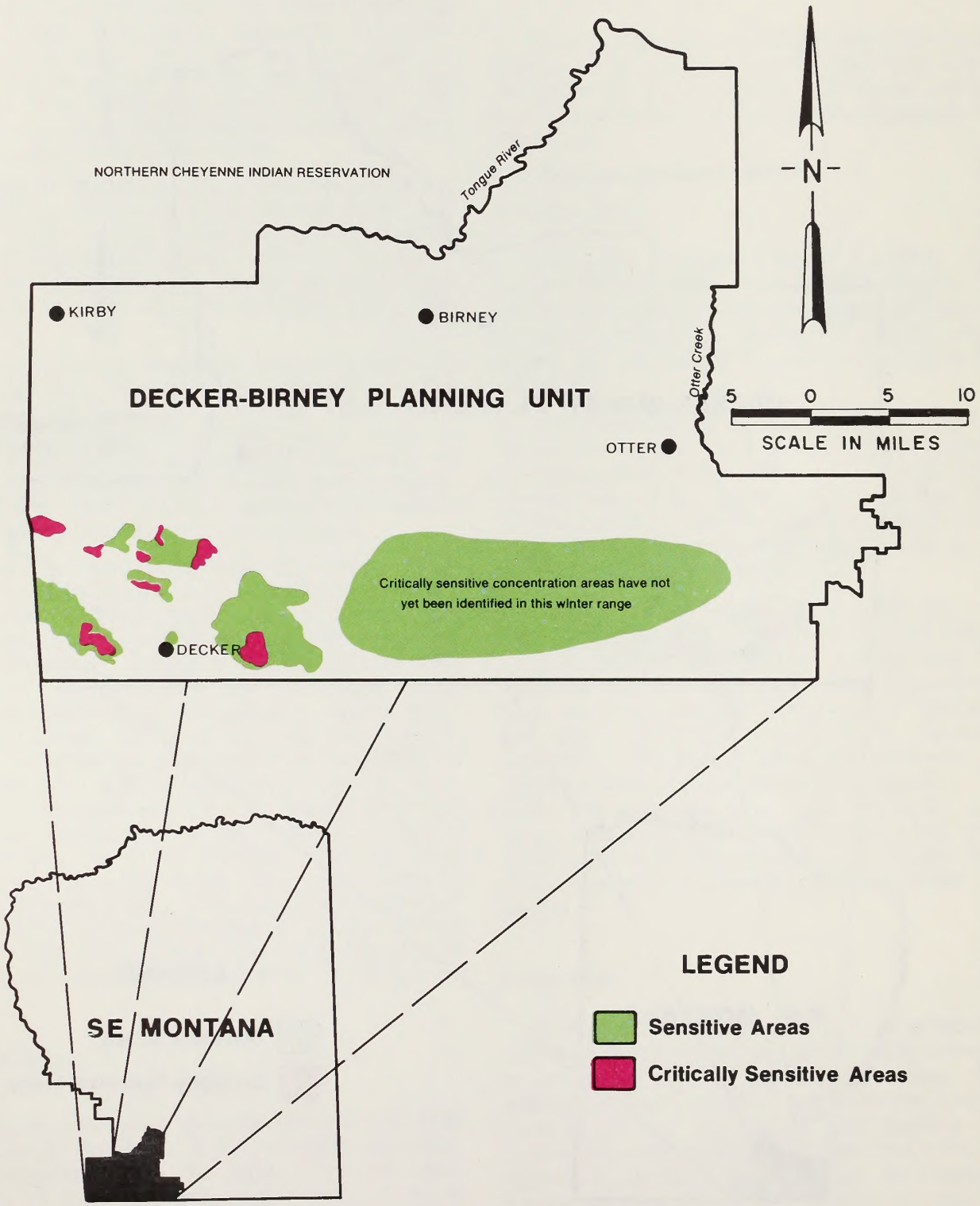
EXAMPLE OF MULE DEER SENSITIVITY RATINGS



SOURCE: U.S. Fish and Wildlife Service, 1979.

FIGURE 2—16

EXAMPLE OF ANTELOPE SENSITIVITY RATINGS



SOURCE: Montana Dept. of Fish, Wildlife, and Parks, 1979 and U.S. Fish and Wildlife Service, 1979.

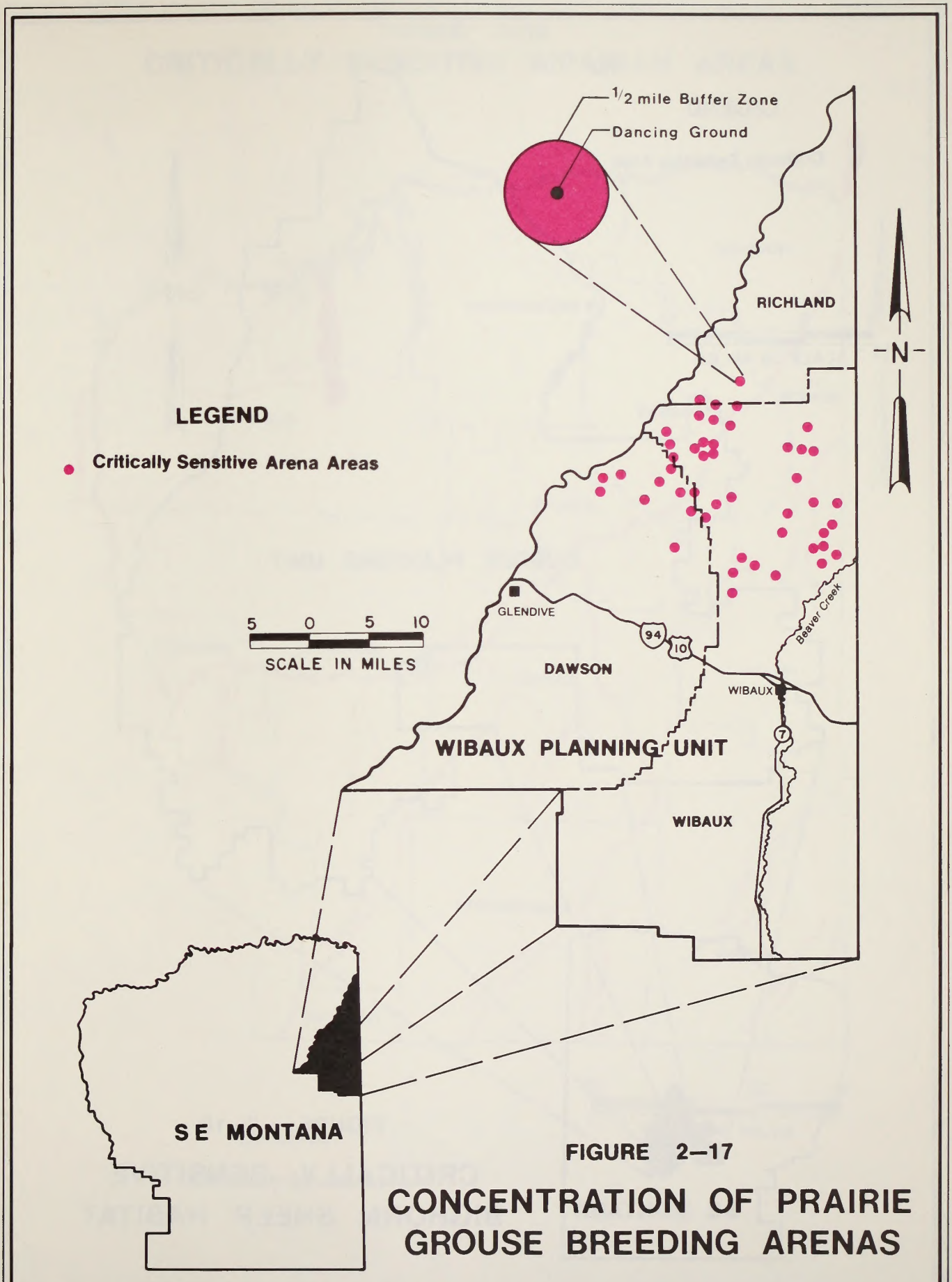


FIGURE 2—17

CONCENTRATION OF PRAIRIE GROUSE BREEDING ARENAS

SOURCE: Miles City District B.L.M., 1979.

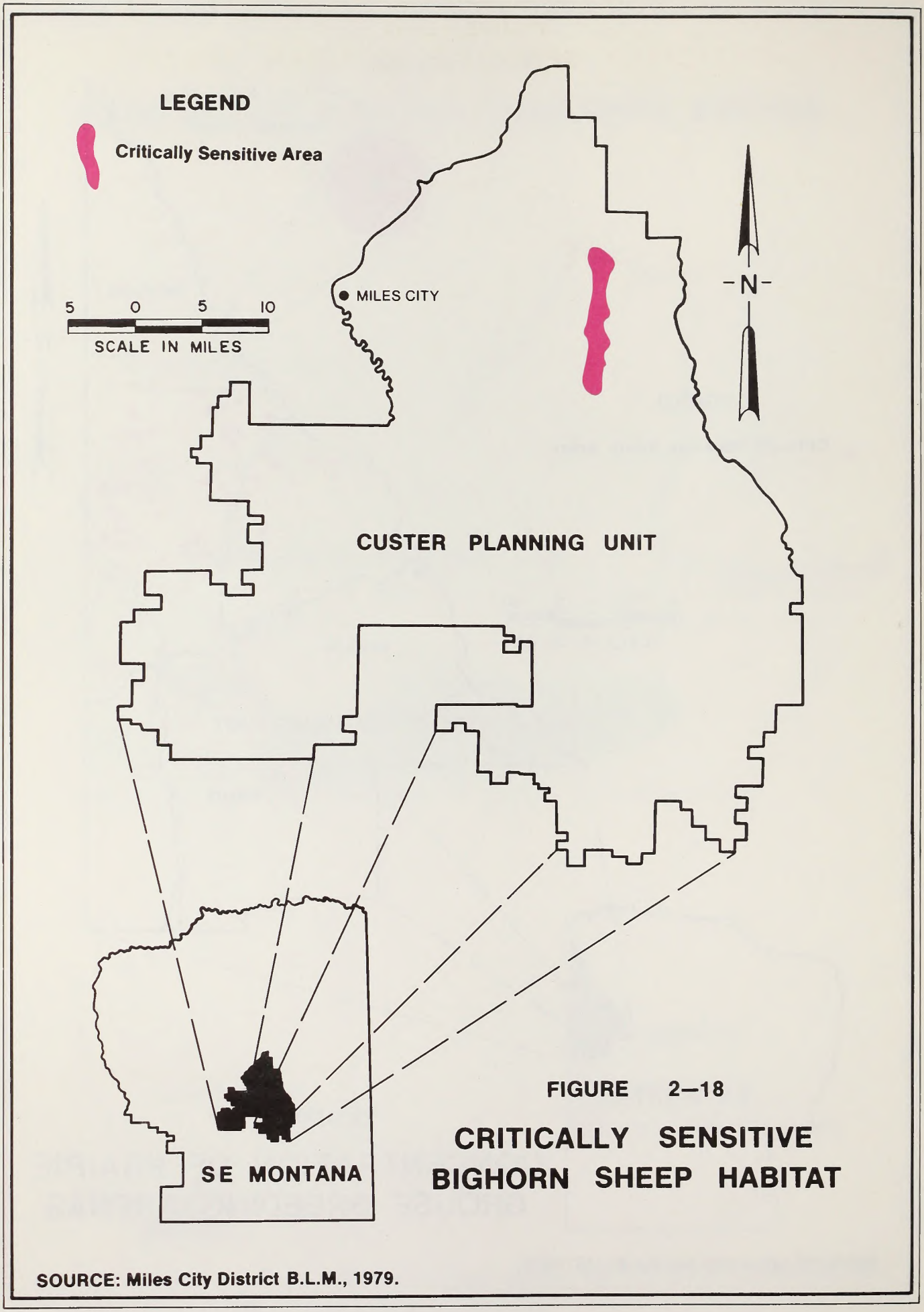


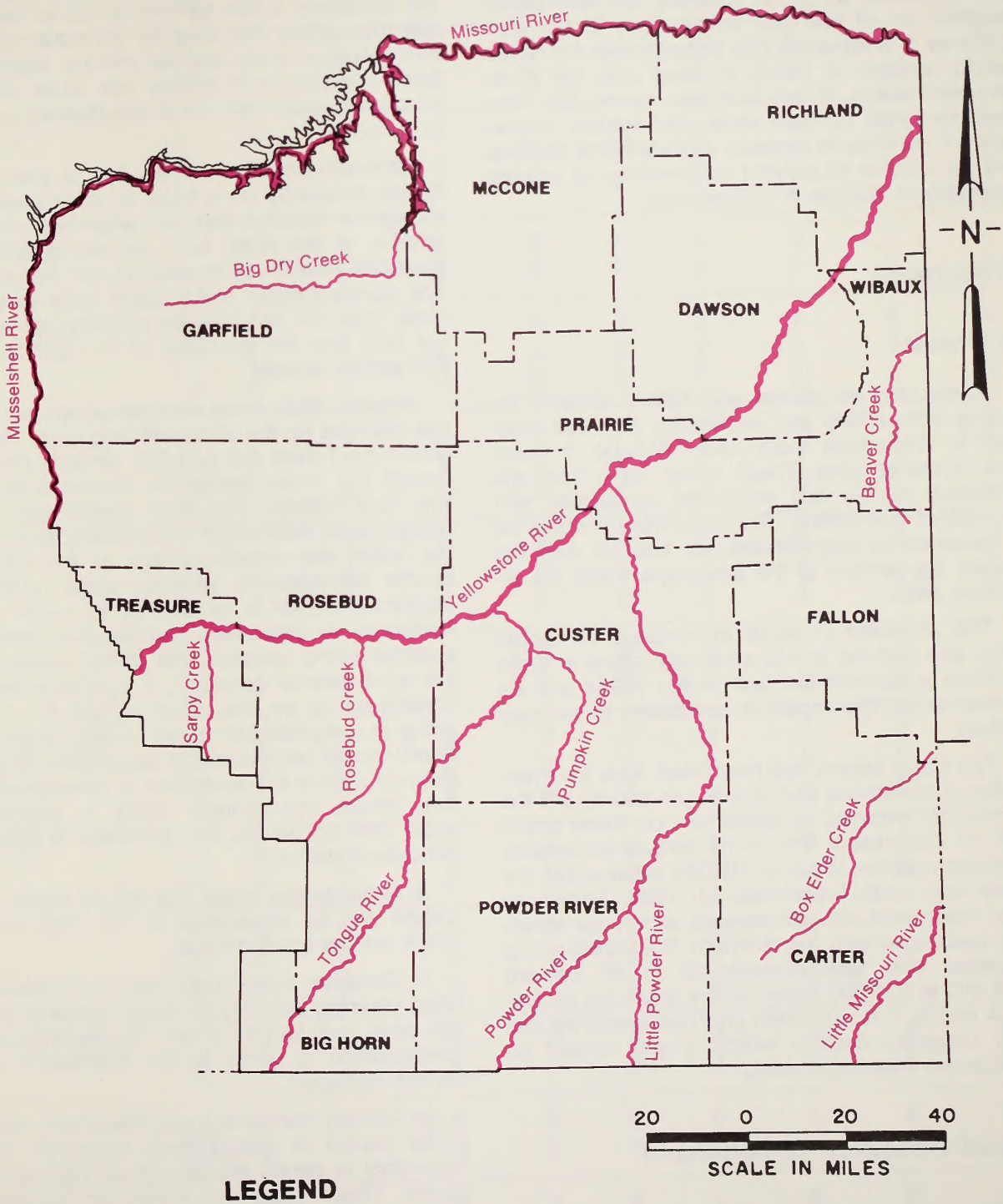
FIGURE 2—18

CRITICALLY SENSITIVE BIGHORN SHEEP HABITAT

SOURCE: Miles City District B.L.M., 1979.

FIGURE 2–19

CRITICALLY SENSITIVE RIPARIAN AREAS



SOURCE: Miles City District B.L.M., 1979.

Abandonment

The abandonment phase would result in a further decrease of direct pressure on recreational facilities as oil and gas employment in the area declines. It is assumed that population in the region would continue to slowly increase after the abandonment phase. If this increase occurs, the long-term demands for both urban and outdoor recreation will continue to increase and additional facilities will be needed to prevent deterioration of existing recreational facilities or experiences.

Wilderness

All Phases

There may be off-site and indirect impacts resulting from drilling and exploration activities adjacent to Wilderness Study Areas (WSAs) or intensive inventory units. These would result from the increased activity and equipment associated with exploration and drilling. The major impact would be a reduction in opportunities for solitude and the natural appearance of the landscape within the inventory units.

The projected increase in numbers of people living and working in the area may cause a slight increase in recreational use of the WSAs and inventory units. This impact is considered to be insignificant.

The major impact that may result from the interaction of wilderness and oil and gas activity are the constraints imposed by wilderness on these activities. At the present time, a no surface occupancy restriction applies to some 749,025 acres within the study area until September 30, 1980. Based on past experience with accelerated wilderness inventory associated with the Northern Tier Pipeline, it is expected that approximately 25 to 30 percent (185,000 to 222,000 acres) of the areas will go into WSA status. The restriction on these areas will last until Congress decides which, if any, should be designated wilderness areas.

Visual Resource Management

The degree that various oil and gas activities can be seen in the landscapes identified in Chapter 4, Affected Environment has been measured using the contrast rating system. Contrast ratings were made for two conditions within each landscape: first for the worst/normal condition, and, second for the optimum condition.

The worst/normal situation is from a normal observer position with the activity in a location that is the least flattering. If an activity is acceptable under this condition, it can be considered to be acceptable throughout the area for purposes of evaluation. Because areas are not uniform, however, detailed analysis on a site by site basis cannot be precluded unless the site is investigated and found to be typical.

Optimum conditions make use of planning and design measures on a case by case basis. Small changes in location that take advantage of characteristics of the land, such as favorable slope or favorable location of vegetation, can be estimated. The contrast rating under these more ideal conditions show the potential for adapting an activity to the land and the capability of the land to absorb that activity visually.

Impacts have been determined for key oil and gas activities for the short and long term. These are shown on Tables 2-5 and 2-6. Impacts have been placed into three categories: Nonsensitive, Sensitive, and Critically Sensitive. Where the contrast ratings have determined that visibility of an activity lies within the numeric criteria of the Visual Resource Management objective class (VRMC), no significant impact is considered to result and the landscape is considered Nonsensitive. Where the contrast rating exceeds the VRMC criteria under the worst/normal condition, a significant impact is considered to be the result. Where the contrast rating is unacceptable under VRMC criteria under worst/normal conditions but acceptable under optimum conditions the landscape is considered Sensitive. Where the contrast rating is unacceptable under both conditions, the landscape is considered Critically Sensitive.

In Nonsensitive areas, the activity under consideration can be considered to "fit" into the landscape without much difficulty.

In Sensitive areas, more care is necessary. Detailed planning and design should precede all location work and permits should be denied until that consideration is made to the satisfaction of the District Manager.

In Critically Sensitive areas, the action may have to be denied or extraordinary measures may be necessary to permit the activity yet maintain visual quality. These areas are shown on Figures 2-20 through 2-24.

Figures 2-20 through 2-23 are short-term impacts that occur through the phases of development. Figure 2-24 represents long-term impacts after these activities are abandoned. Refining has not been included on these landscapes: in all landscapes, this activity would be highly visible and all

TABLE 2-5

SHORT-TERM IMPACTS

Landscape		Activity CG	TV	WD	FD	R	P	PT	AR	MR
Prairie/Grassland	III	X	0	Ø	Ø	Ø	X	Ø	Ø	X
	IV	X	0	X	Ø	Ø	X	X	X	X
Scabland	III	0	0	Ø	Ø	Ø	0	Ø	X	0
	IV	0	0	Ø	Ø	Ø	0	Ø	X	0
Riparian	II	X	X	Ø	Ø	Ø	X	X	Ø	X
	III	X	0	X	X	Ø	X	X	X	X
	IV	X	0	X	X	Ø	X	X	X	X
Wooded Draws	III	X	0	X	Ø	Ø	X	X	X	X
	IV	X	0	X	Ø	Ø	X	X	X	X
Dense Forest	II	Ø	Ø	Ø	Ø	Ø	Ø	X	Ø	Ø
	III	Ø	X	Ø	Ø	Ø	X	X	Ø	Ø
	IV	X	X	Ø	Ø	Ø	X	X	X	X
Forest	II	X	X	Ø	Ø	Ø	Ø	Ø	Ø	X
	III	X	0	Ø	Ø	Ø	X	X	X	X
	IV	X	0	0	0	Ø	0	0	X	X
Savannah	II	X	0	Ø	Ø	Ø	Ø	X	Ø	X
	III	X	0	Ø	Ø	Ø	X	X	X	X
	IV	X	0	0	Ø	Ø	X	X	X	X
Agriculture	III	0	0	Ø	Ø	Ø	X	X	0	X
	IV	0	0	X	Ø	Ø	X	0	0	X
Urban/Suburban	II	0	0	Ø	Ø	Ø	Ø	X	0	0
	III	0	0	Ø	Ø	Ø	Ø	X	0	0
	IV	0	0	Ø	Ø	Ø	Ø	X	0	0
Badlands	II	Ø	X	Ø	Ø	Ø	Ø	Ø	Ø	Ø
	III	X	0	Ø	Ø	Ø	Ø	X	X	X
Breaks	II	Ø	0	Ø	Ø	Ø	Ø	Ø	Ø	Ø
	III	X	0	Ø	Ø	Ø	Ø	X	Ø	X
	IV	X	0	Ø	X	Ø	Ø	X	X	X
Forested Breaks	II	Ø	X	Ø	Ø	Ø	Ø	Ø	Ø	Ø
	III	X	X	Ø	Ø	Ø	X	X	X	X
Buttes	II	X	X	Ø	Ø	Ø	Ø	Ø	Ø	X
	III	X	X	Ø	Ø	Ø	X	Ø	X	X
Sand Hills	III	X	0	Ø	Ø	Ø	X	Ø	Ø	X
	IV	0	X	X	Ø	Ø	0	X	Ø	X

CG = Conventional Geophysical
TV = Thumper/Vibrator Geophysical
WD = Wildcat Well Drilling
FD = Field Development
R = Refining
P = Pipelines
PT = Local Power & Telephone
AR = Access Roads
MR = Maintenance Roads

0 = Nonsensitive
X = Sensitive
Ø = Critically Sensitive

SOURCE: BLM, 1979

TABLE 2-6

LONG-TERM IMPACTS

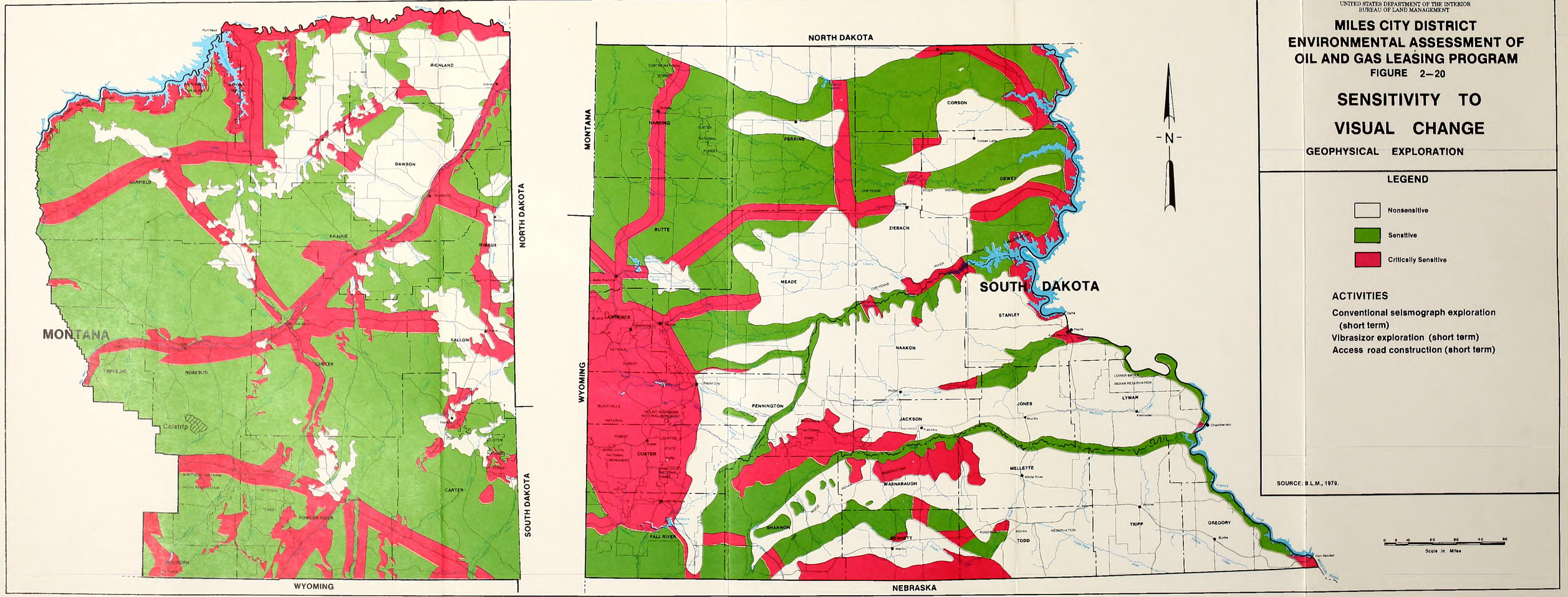
Landscape		Activity CG	TV	WD	FD	R	P	PT	AR	MR
Prairie/Grassland	III	0	0	X	X	Ø	0	X	X	X
	IV	0	0	X	X	Ø	0	X	X	X
Scabland	III	0	0	0	X	Ø	0	Ø	X	0
	IV	0	0	0	X	Ø	0	Ø	0	0
Riparian	II	X	0	0	X	Ø	X	X	X	X
	III	X	0	0	X	Ø	X	X	X	X
	IV	X	0	0	0	Ø	X	X	X	X
Wooded Draws	III	X	0	X	X	Ø	X	X	X	X
	IV	X	0	X	0	Ø	0	0	X	0
Dense Forest	II	X	X	Ø	Ø	Ø	X	Ø	Ø	Ø
	III	0	0	X	Ø	Ø	X	X	X	Ø
	IV	0	0	X	X	Ø	X	X	0	X
Forest	II	X	0	X	X	Ø	X	X	X	X
	III	0	0	0	0	Ø	0	0	X	X
	IV	0	0	0	0	Ø	0	0	X	X
Savannah	II	X	0	X	X	Ø	X	X	X	X
	III	0	0	0	X	Ø	X	0	X	X
	IV	0	0	0	0	Ø	X	0	0	X
Agriculture	III	0	0	0	0	Ø	X	X	0	X
	IV	0	0	0	0	Ø	X	0	0	X
Urban/Suburban	II	0	0	0	0	Ø	Ø	X	0	0
	III	0	0	0	0	Ø	Ø	X	0	0
	IV	0	0	0	0	Ø	Ø	X	0	0
Badlands	II	Ø	X	X	Ø	Ø	Ø	X	X	Ø
	III	X	0	X	Ø	Ø	X	X	X	X
	IV	X	0	X	Ø	Ø	X	X	X	X
Breaks	II	X	0	X	Ø	Ø	Ø	X	X	Ø
	III	X	0	X	X	Ø	X	X	X	X
	IV	0	0	0	X	Ø	X	X	X	X
Forested Breaks	II	X	0	X	Ø	Ø	X	Ø	X	Ø
	III	X	0	X	X	Ø	X	X	X	X
Buttes	II	X	X	X	Ø	Ø	X	Ø	X	X
	III	X	X	0	X	Ø	X	Ø	X	X
Sand Hills	III	X	0	X	X	Ø	X	X	X	X
	IV	X	0	X	X	Ø	0	X	X	X

CG = Conventional Geophysical
WD = Wildcat Well Drilling
R = Refining
PT = Local Power & Telephone
MR = Maintenance Roads

TV = Thumper/Vibrator Geophysical
FD = Field Development
P = Pipelines
AR = Access Roads

0 = Nonsensitive
X = Sensitive
Ø = Critically Sensitive

SOURCE: BLM, 1979



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MILES CITY DISTRICT ENVIRONMENTAL ASSESSMENT OF OIL AND GAS LEASING PROGRAM

FIGURE 2—20

SENSITIVITY TO VISUAL CHANGE

GEOPHYSICAL EXPLORATION

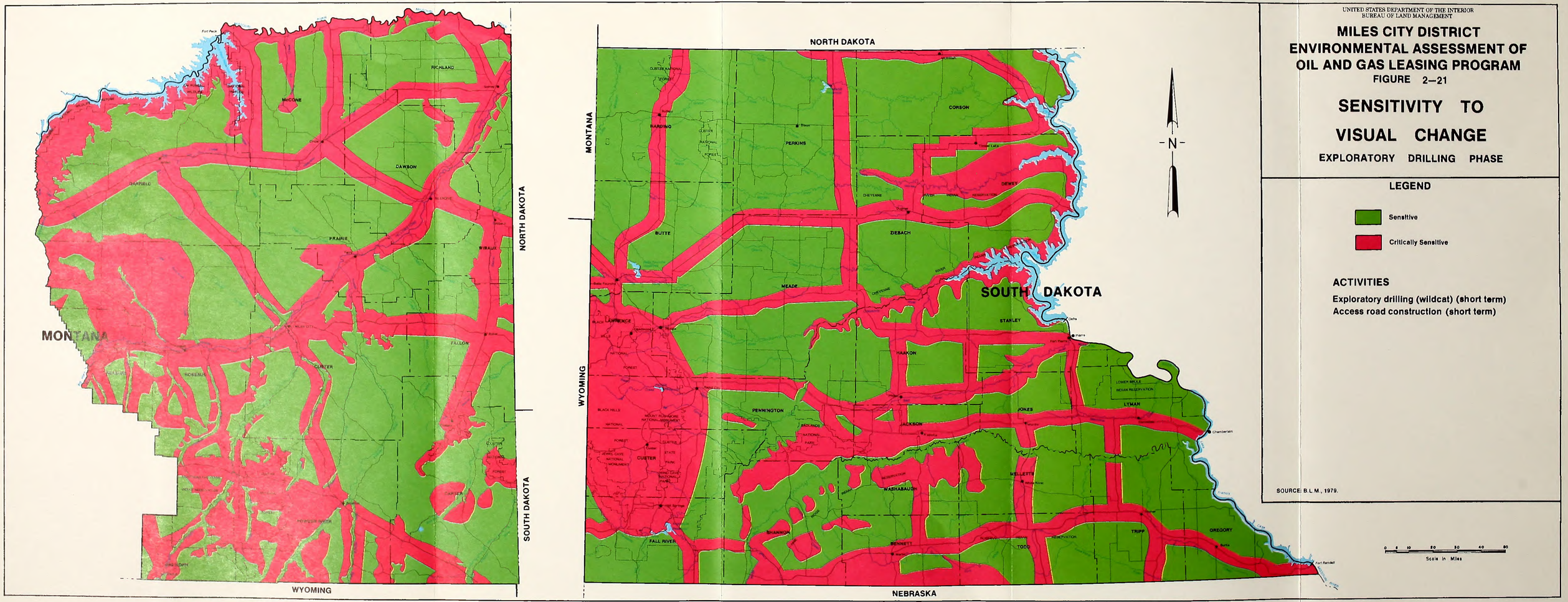
LEGEND

- Nonsensitive
- Sensitive
- Critically Sensitive

ACTIVITIES

Conventional seismograph exploration (short term)
Vibrasizor exploration (short term)
Access road construction (short term)

SOURCE: B.L.M., 1979.



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MILES CITY DISTRICT ENVIRONMENTAL ASSESSMENT OF OIL AND GAS LEASING PROGRAM

FIGURE 2–21

SENSITIVITY TO VISUAL CHANGE

EXPLORATORY DRILLING PHASE

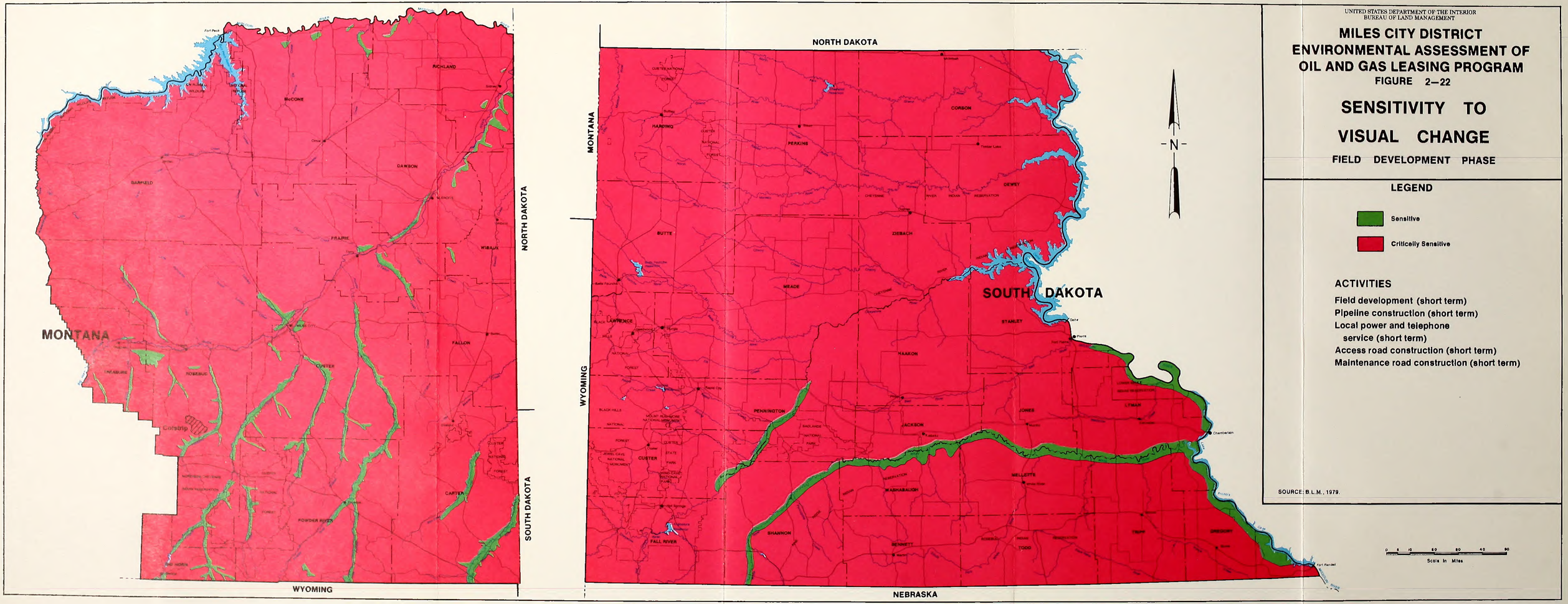
LEGEND

- Sensitive
- Critically Sensitive

ACTIVITIES

Exploratory drilling (wildcat) (short term)
Access road construction (short term)

SOURCE: B.L.M., 1979.



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MILES CITY DISTRICT ENVIRONMENTAL ASSESSMENT OF OIL AND GAS LEASING PROGRAM

FIGURE 2—22

SENSITIVITY TO VISUAL CHANGE

FIELD DEVELOPMENT PHASE

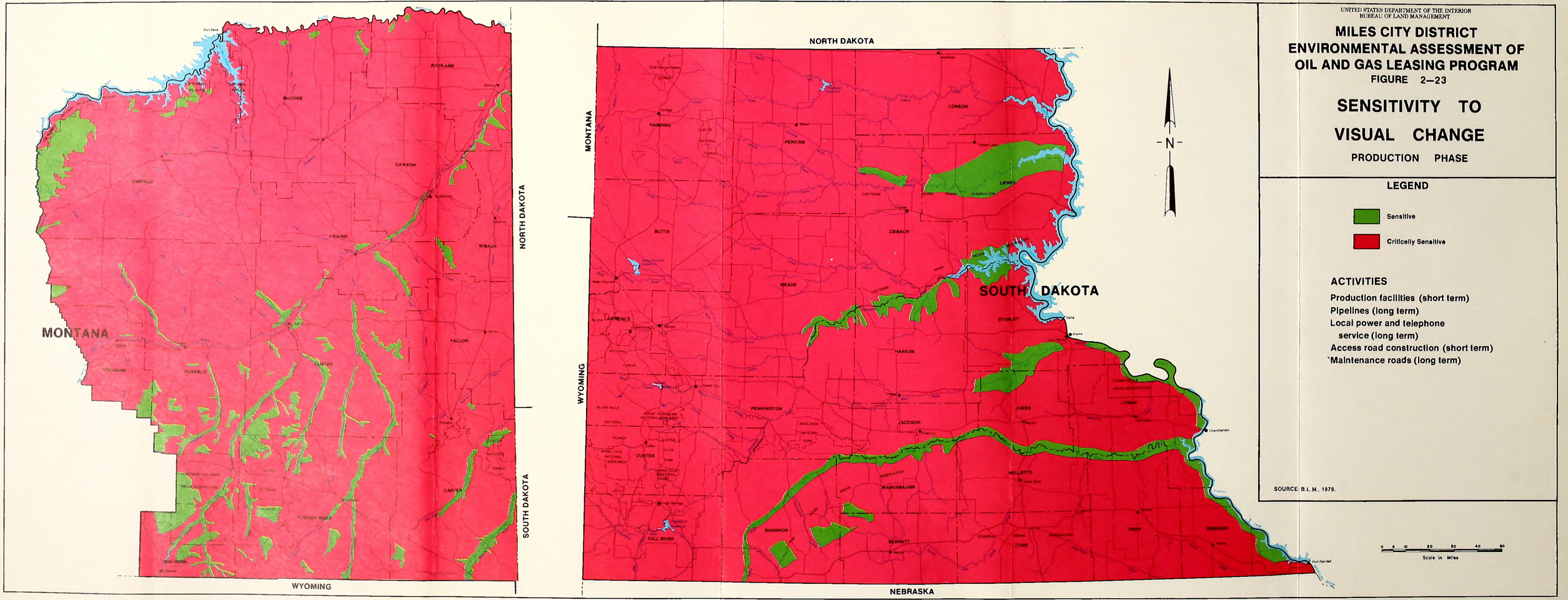
LEGEND

- Sensitive
- Critically Sensitive

ACTIVITIES

Field development (short term)
Pipeline construction (short term)
Local power and telephone service (short term)
Access road construction (short term)
Maintenance road construction (short term)

SOURCE: B.L.M., 1979.



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MILES CITY DISTRICT ENVIRONMENTAL ASSESSMENT OF OIL AND GAS LEASING PROGRAM

FIGURE 2–23

SENSITIVITY TO VISUAL CHANGE

PRODUCTION PHASE

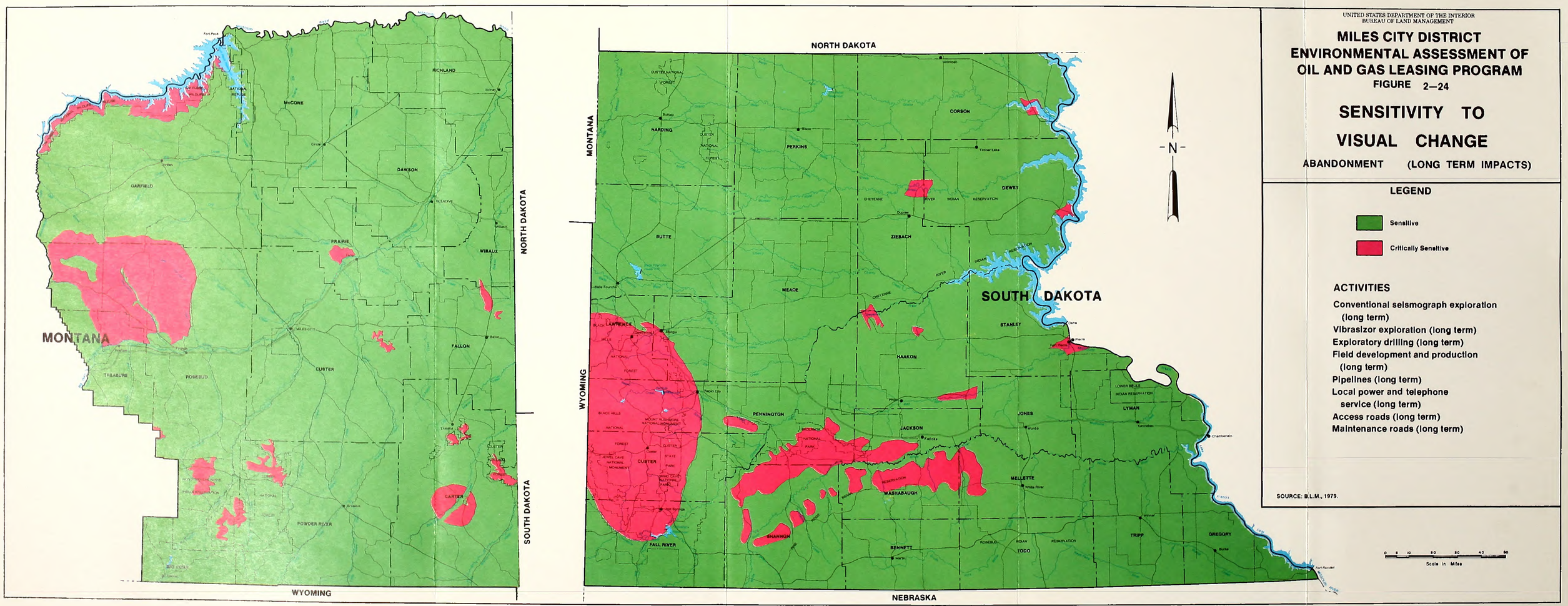
LEGEND

- Sensitive
- Critically Sensitive

ACTIVITIES

Production facilities (short term)
Pipelines (long term)
Local power and telephone service (long term)
Access road construction (short term)
Maintenance roads (long term)

SOURCE: B.L.M., 1979.



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MILES CITY DISTRICT ENVIRONMENTAL ASSESSMENT OF OIL AND GAS LEASING PROGRAM

FIGURE 2—24

SENSITIVITY TO VISUAL CHANGE

ABANDONMENT (LONG TERM IMPACTS)

LEGEND

- Sensitive
- Critically Sensitive

ACTIVITIES

Conventional seismograph exploration (long term)
Vibrasizor exploration (long term)
Exploratory drilling (long term)
Field development and production (long term)
Pipelines (long term)
Local power and telephone service (long term)
Access roads (long term)
Maintenance roads (long term)

SOURCE: B.L.M., 1979.

landscapes are, therefore, Critically Sensitive to this action.

Activities may apply to more than one phase of development. The activities that apply to the phase represented on each figure may be found on the legend.

Any of the oil and gas activities can be accomplished in harmony with the landscape with sufficient planning, sufficient care, and sufficient economic resources. In every case it will require more thought and more money to do an adequate job, but the economic burden of protecting the land yet developing oil and gas resources can be lightened through planning and site design. In Critically Sensitive areas the cost of that "adequate" job may exceed the payoff from the resource and under these conditions the decision must be made whether a sacrifice of the activity or of the land must be made.

During the period of occupancy the visual effect of activities is quite different from the traces of activity that remain in the long term. The perception of the activity during operating phases may elicit curiosity and interest or disgust. After the activity has been discontinued, however, inharmonious remnants in the natural and agrarian landscape, with few exceptions, are considered by most individuals to be counter-productive, wasteful, and unsightly. During the actual operations, oil and gas development appears to be the use of the area and within this area can be viewed as necessary and productive if not attractive visually: there is a "fit" of the use in the public's perception. Afterwards, however, the dominant use is agrarian and certain kinds of remaining disturbance do not "fit." Exceptions are features of historical value, which may generate interest, and those rare locations, such as in industrial areas in towns and cities, where the differences in character are imperceivable.

In all cases, unless through improper cleanup of the area, the long-term impacts result through changes in vegetation from unsuccessful rehabilitation, and through changes in landform. The site of spoiled unproductive land and of inharmonious land character is contrary to the consciousness of essentially agrarian residents.

Prehistoric and Historic Features

Approximately 1% of the study area has been inventoried for prehistoric and historic features; consequently, the exact location of critical impact areas cannot be determined at this time. Known Geologic Structures (KGSs) and areas open to noncompetitive leasing have received less than 1% inventory. The small amount of inventory has shown, however, that some impacts to prehistoric and historic features are likely to occur as a result of oil and gas activity. Thus far, inventories in the northwestern, extreme eastern, and southern portions of the study area show a range of site density from 0.5 to 6.0 sites per square mile (640 acres). No areas are completely devoid of cultural resource sites, while some areas have a relatively high density (Figure 2-25). To date, no areas of high site density have been identified in South Dakota.

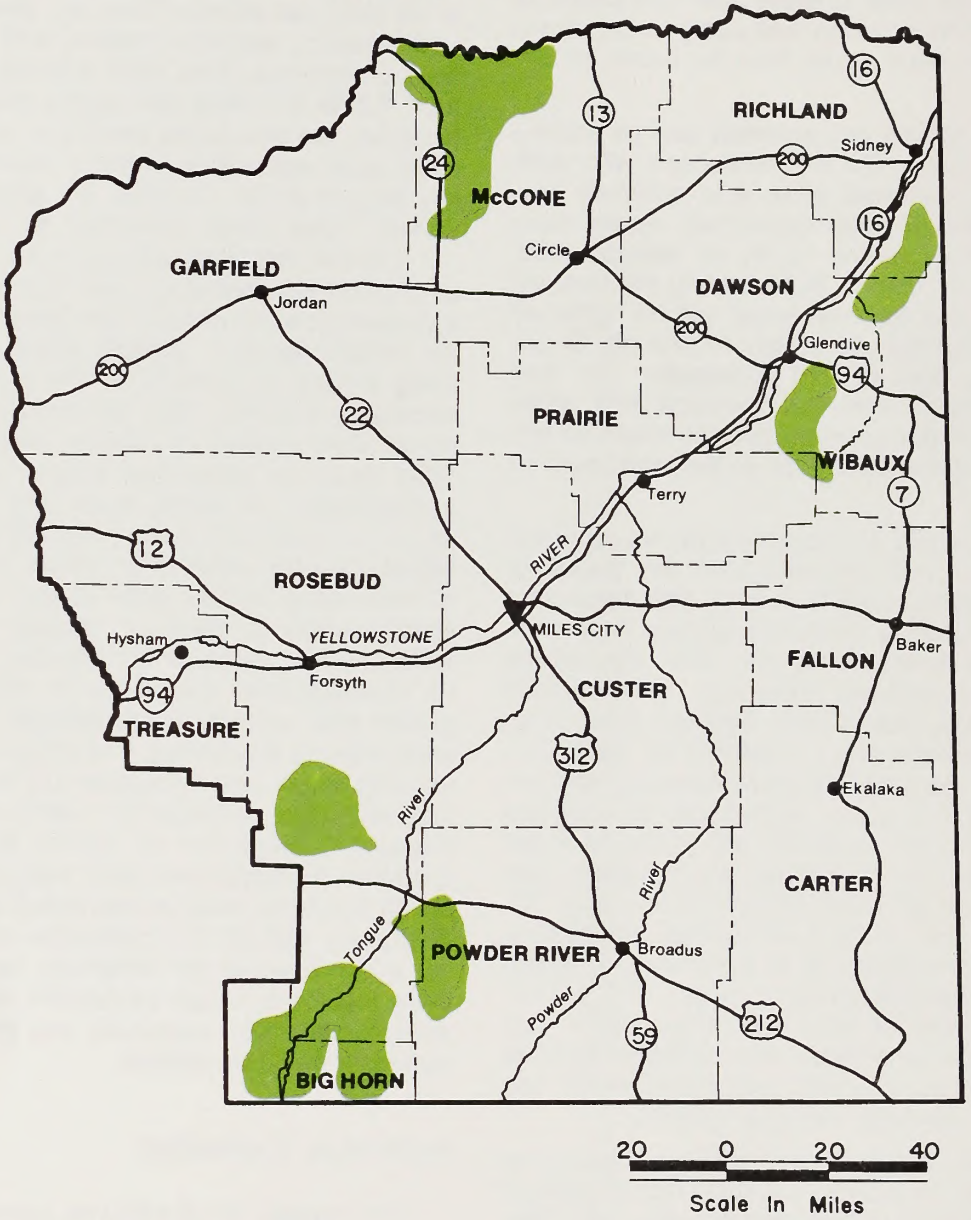
Ground disturbing activity is the primary cause of impacts on prehistoric and historic features. An archaeological or historic site consists of features (or structures) and artifacts which represent the living activity of humans in the past. In order to accurately interpret what the features and artifacts mean, their context or relative position to one another must be preserved intact. For example, a concentration of stone tools and animal bones which are located in close proximity to a fire hearth would allow the event to be dated, an interpretation of how many people were at the prehistoric site, what animals or parts of animals were used as food, and from species identification, a general idea of environmental conditions in the area. If the ground that contains these features is disturbed by earth moving equipment, it would probably result in at least three basic impacts: (1) the objects and features could no longer be related to one another because it could not be proved that the objects scattered by equipment once were located together; (2) the bone material and hearth could be totally destroyed; and (3) the interpretive value of remaining artifacts would be drastically reduced because there would no longer be datable material, organic materials could be destroyed, and the context of all materials would be altered.

Preliminary Exploration

The majority of procedures associated with this phase do not entail significant ground disturbing activity. However, certain terrain problems or specific methods could impact prehistoric or historic features. Even though rubber-tired trucks are normally used, rough terrain or drainage crossings may require dirt work. It is not possible to delineate major areas of the district where geophysical operations would not require limited road construction. Although some areas have generally rolling or gentle topography, isolated areas exist within these areas which would require further work before rubber-tired vehicles could be used. The other geophysical operation which could impact prehistoric or historic sites is the use of explosives to generate measurable sound waves. If explosives are used on

FIGURE 2–25

RELATIVELY HIGH ARCHAEOLOGICAL SITE DENSITY



LEGEND

Sensitive Areas

SOURCE: Miles City District Class I Cultural Resource Inventory.

or near the surface, they could cause exfoliation or cratering and thereby damage sites.

Exploratory Drilling and Development

Exploratory drilling and development of oil and gas resources are usually the major activities impacting prehistoric and historic features. These actions almost always require construction of a drill pad, and for development, ancillary facilities including mudpits, waste piles, reserve pits, tanks and flowlines. Although not always the case for exploration drilling, road construction would be required in most cases. All of these activities would severely damage and probably destroy any historic or prehistoric site located where development would occur.

Production

Production would not cause further ground disturbance unless new wells were developed in addition to those initial successful exploration wells. Impacts would then be limited to the location and pad of any new wells or to the oil/gas gathering lines or roads serving new wells.

Abandonment

Abandonment would cause no impacts to prehistoric and historic features, unless rehabilitation of the well site entailed new ground disturbance beyond that of the original drill pad and facilities construction.

The probable magnitude of impacts mentioned above can be anticipated for some areas of the district where cultural resource inventory is available. Since most of the prehistoric sites recorded can contribute some information to cultural studies, they are classified as Sensitive. Most of the known historic sites also fall into this class, primarily because they have not been fully evaluated.

A few sites recorded to date are known to have exceptional value because they may yield important scientific informaton or because they have some potential for interpretation and public enjoyment. These sites are classified as Critically Sensitive. This class also includes several historic sites which have not been precisely located on the ground and will need further research before leasing. Most areas within the district have never been extensively inventoried for cultural resources and therefore are areas in the Requires Further Study category.

The Map Overlay File presently shows the following situation for classification of impact sensitivity concerning cultural resources. About 17 of the sections of public surface in Garfield County that have been inventoried are identified as Nonsensitive, because they contain no observable prehistoric or historic features. In Wibaux and Dawson Counties south of the Yellowstone River, however, nearly every section inventoried contains one or more sites, putting them into the Sensitive category. Oil and gas operations will not impact cultural resources in Nonsensitive areas, except when ground disturbing activity locates previously unknown buried cultural material. Sensitive areas would be impacted if ground disturbing oil and gas operations (discussed above) coincide with the exact site of prehistoric or historic activity.

At present, only a few sites are known that constitute Critically Sensitive historic and prehistoric areas (Table 2-7). They include the important and extensive prehistoric Hagen Site, Taylor-Siegel Site, Mueller Site, Kobold Site, Foss-Thomas Site, Ayers-Frazer Site, Whisky Hill Site, Yonkee-Powers Site, Nollmeyer Site, and the Flint Hill Quarry Site; and the historic Fort Meade, Rosebud Battlefield, Reynolds Battlefield, and Battle of the Butte (Figure 2-26). Other potential Critically Sensitive sites in this category need to be field verified. They include the historic Baldwin's Fight on the Redwater, the Cole-Walker Battles, Miles' Fight on Cedar Creek, the Terry Supply Camp and other features at the mouth of the Powder River, and the Big Horn Historic District at the mouth of the Big Horn River. Few of these sites are within a KGS; however, any of them could be impacted by non-competitive leasing activities.

Economic and Social Conditions

Eastern Montana

Economic and social impacts resulting from oil and gas activity are most likely to occur during a large-scale field development phase. Furthermore, these impacts would, in almost all cases, center within the communities in which the oil and gas workers choose to reside and/or recreate. The most immediate economic and social impacts in areas of past oil and gas activity center around the population influx attracted by increased earnings and employment. In addition, housing and other basic infrastructural requirements (e.g., water supply, sewage treatment, recreational opportunities, schooling, to mention a few) must be available to accommodate any sizeable population influx (e.g. 20% growth over a 4-6 year period).

TABLE 2-7

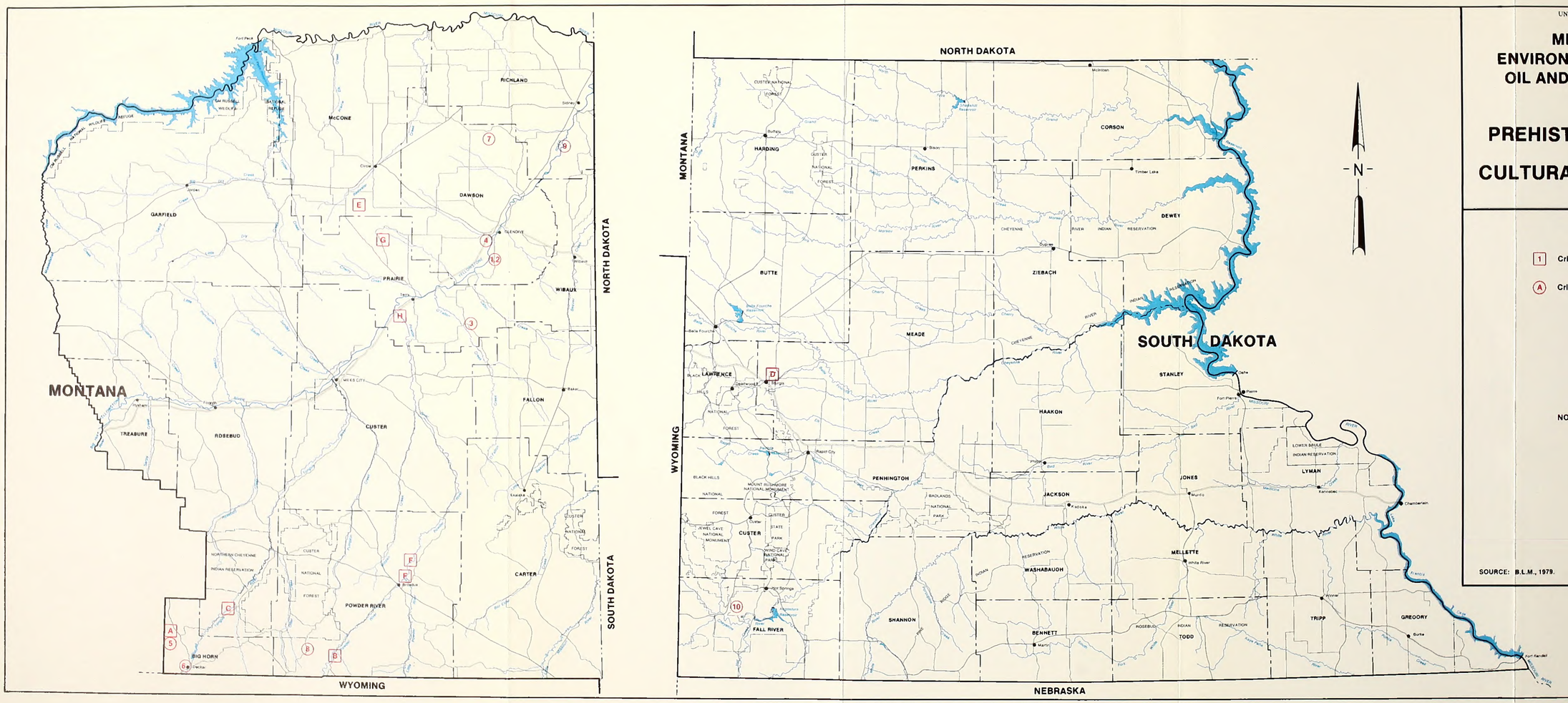
CRITICALLY SENSITIVE PREHISTORIC FEATURES

Map Number	
1	The Taylor-Siegel Site is a single component Late Prehistoric Period base camp. It is located on public land and mineral estate in the Gas City Oil Field.
2	The Muller Site is an Early Prehistoric Period site, possibly a bison kill, located on public land and mineral estate in the Gas City Oil Field.
3	The Ayers-Frazier Bison Trap is a single-event arroyo bison trap located on public land and mineral estate. It is not near a KGS.
4	The Hagen Site is a Late Prehistoric campsite with possible Middle Missouri affiliation. It is within three miles of the Glendive KGS.
5	The Kobold Site is a multi-component bison jump located on private surface with only the coal reserved for the public. It is not near a KGS.
6	The Foss-Thomas Site is a Late Prehistoric Period bison kill site on private surface. The mineral estate at the site is privately owned. It is not near a KGS.
7	The Whisky Hill Site is a Late Prehistoric Campsite with pottery. It is located on private land. A portion of the coal under the site belongs to the public. It is not near a KGS.
8	The Powers-Yonkee Site is a Middle Prehistoric Period arroyo bison trap. It is privately owned and not near a KGS.
9	The Nollmeyer Site is a Late Prehistoric Period ceramic camp. It is privately owned.
10	The Flint Hill Quarry Site is a National Register property near Minnekahta, South Dakota. It is privately owned, but the minerals belong to the public.

CRITICALLY SENSITIVE HISTORIC FEATURES

Map Letter	
	Sites With Well-Defined Locations
A	The Rosebud Battlefield Site is the scene of a major military-Indian engagement in the 1876 War. It is currently listed on the National Register of Historic Places. The site is privately owned with some of the mineral estate belonging to the public. It is not near a KGS.
B	The Reynold's Battlefield Site is the scene of the opening Indian-Cavalry conflict in the 1876 Sioux Indian War. It has been determined eligible for the National Register of Historic Places. Portions of the site are public land and minerals. It is not near a KGS.
C	The Battle of the Butte Site is where Col. Nelson Miles' troops confronted Crazy Horse's Sioux in January, 1877. Most of the site is on private land, but some of the minerals are owned by the public. It is not near a KGS.
	Sites Which Need Further Study to Learn Their Location and Value
E	Baldwin's Fight on the Redwater is a December, 1876, battle site between U.S. troops and Sioux Indians. It is reportedly on private land and not near a KGS.
F	The Cole-Walker Battle Sites date to an 1865 military expedition to the Powder River. About four battle sites are only vaguely known. They are not near a KGS.
G	The Miles' Fight on Cedar Creek is another 1876 battle between troops and Sitting Bull's people. It is not near a KGS.
H	Terry's Supply Camp was a supply depot at the mouth of Powder River used in 1876-1877. It is not near a KGS.

SOURCE: Miles City District Class I Archaeological Inventory Files 1979.



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MILES CITY DISTRICT ENVIRONMENTAL ASSESSMENT OF OIL AND GAS LEASING PROGRAM

FIGURE 2—26

PREHISTORIC AND HISTORIC CULTURAL SITES SENSITIVITY

LEGEND

1 Critically Sensitive Prehistoric Cultural Resource Site

A Critically Sensitive Historic Cultural Resource Site

NOTE: Refer to Table 2-7 for description of sites.

SOURCE: B.L.M., 1979.

Development

For the purposes of this analysis, it is assumed that likely direct and indirect employment levels associated with development of a major oil and gas field are as follows: 190 direct, 173 indirect, 363 total.

These direct employment levels were observed in the Bell Creek field of southeastern Montana which experienced major oil and gas development in the late 1960s. The remaining phases of oil and gas activity are not expected to create significant economic or social impacts and are not analyzed further.

For the purpose of this analysis, it is assumed that 50% of all direct oil/gas development workers are married, and that 50% of those bring their families with them (i.e., 25% of the total or 48 workers). Consequently, it is likely that major field development would result in a total direct population association of approximately 310 individuals, assuming 3.5 members per family (i.e., 142 (48 x 3.5)). The indirect workers would most likely be available in the area and consequently not result in an inmigration of workers/families.

In most cases, the inmigrating married workers with families present would prefer to reside in houses/apartments in town, while the workers without families would generally be more likely to live in trailers/campers. Consequently, of the 190 total direct workers involved with the development stage of a major field, all 48 with families present are assumed to seek housing in town. Of the remaining 142 workers, 71 (i.e., 50%) are assumed to attempt to find housing in town, assuming that all the workers without families present choose to live separately rather than sharing a dwelling unit, with the remainder (71) living in trailer houses on the outskirts of town or near the development site.

This implies that a work force of this magnitude would require approximately 119 housing units (48 71), excluding trailers, in a town within commuting distance of the oil/gas field. Note that the population influx into a town within commuting distance from a major field would be approximately 240 people (71 without families and 48 with families at 3.5 members per family).

Based upon this impact scenario, it is possible to estimate each community's general sensitivity concerning impacts resulting from nearby oil/gas field development. The above direct population and employment levels expected to be associated with major field development constitute approximately 0.5% of the study area's total estimated 1980 population level, and 0.7% of the 1976 employment level. While this is not a significant impact when measured across the entire study area, it could create severe problems if it occurred in one of the communities within the study area. Table 2-8 shows the percentage change in population and employment levels, respectively, in each county/community if major oil/gas field development or this level occurred nearby. It is, of course, unlikely that major field development would occur in all of the locations in Table 2-8. However, the table does show what the local impact would be if major development does occur in one or more of these locations.

As Table 2-8 shows, most counties in the study area have a community which would experience a 10% or greater increase in population if the estimated population influx associated with major field development were to actually occur during a period of 2-3 years. Similarly, 8 of the 12 counties would experience employment increases in excess of 10% as a result of the direct employment associated with major field development.

Although the likely impacts from full major field development would be relatively short-lived in duration (i.e., 4-6 years), the intensity of the impacts could be severe in communities which do not have excess service capacity with respect to water, health services, sewage teatment, and other infrastructure items. It is assumed that any community which experiences a 20% growth in population as a result of energy development during this 4-6 year period would experience problems providing housing and basic public services. For this reason, the major economic and social impact indicator used in this analysis is the effect of the population influx (approximately 240 people) associated with major oil or gas field development on a community's general infrastructure.

Health problems associated with oil and gas activity can be generally categorized as either mechanical accidents or poisonings, primarily from hydrogen sulfide. Mechanical accidents (e.g., vehicular, drill rig machinery, etc.) account for most of the deaths/accidents associated with oil and gas activity. In Montana, oil and gas work ranks second, behind logging, in the number of deaths/injuries per 200,000 man hours and has double the average injury rate of all economic sectors statewide (20.4 vs. 10.2/200,000 man hours).

Hydrogen sulfide can pose serious health problems in the course of oil and gas work. It is heavier than air and tends to concentrate in low lying, enclosed areas. It is encountered as a by-product in oil and gas drilling and treatment facilities. Hydrogen sulfide can, in concentrations of 1,000 parts per million (i.e., 10%), cause immediate unconsciousness (Table 2-9). Although it is not possible to obtain statistics on the incidence of death and injury due to hydrogen sulfide poisoning in the study area, it is reasonable to expect that contin-

TABLE 2-8

ESTIMATED DIRECT POPULATION AND EMPLOYMENT IMPACTS[1/]
FROM MAJOR FIELD DEVELOPMENT

County/Community	% Population Increase[2/]	% Employment Increase[3/]
Carter	12.9	23.9
Ekalaka	37.5	
Custer	1.8	3.2
Miles City	2.5	
Dawson	2.0	3.5
Glendive	3.6	
Richey	58.5	
Fallon	5.9	10.3
Baker	9.2	
Garfield	14.2	24.5
Jordan	44.5	
McCone	9.5	12.7
Circle	23.0	
Powder River	10.9	16.7
Broadus	30.3	
Prairie	12.7	20.5
Terry	24.3	
Richland	2.1	4.0
Fairview	22.3	
Sidney	5.0	
Rosebud	2.2	4.5
Forsyth	8.4	
Treasure	20.0	41.1
Hysham	39.0	
Wibaux	16.3	30.0
Wibaux	36.6	

1/ Community employment levels not available.
2/ Assuming population influx of 240 people measured against estimated 1980 level.
3/ Assuming direct employment influx of 190 people measured against 1976 level. 1980 employment forecasts are not available.

SOURCE: Uses Table 4-9 for population base levels and Table 4-10 for employment base levels.

TABLE 2-9

HYDROGEN SULFIDE (H_2S) TOXICITY TABLE

Concentration	REACTION
10 ppm[1/] = .001%	Normal sense of smell can detect this level of concentration.
20 ppm = .002%	Safe for 8 hours exposure.
100 ppm = .01%	Sense of smell is killed in 3 to 15 minutes, may sting eyes and throat.
200 ppm = .02%	Sense of smell is killed shortly. Stings eyes and throat
	D E A D L Y R A N G E :
500 ppm = .05%	Loss of sense of reasoning and balance, occurs along with respiratory paralysis in 30 to 45 minutes; needs prompt artificial resuscitation.
700 ppm = .07%	Victim will become unconscious quickly (15 minutes maximum). Breathing will stop and death results if not rescued promptly: immediate artificial resuscitation required.
1,000 ppm = .10%	Unconscious at once. Permanent brain damage could result unless promptly rescued.

1/ Parts per million

SOURCE: BLM, 1979

ued oil and gas work would provide the opportunity for an undetermined number of deaths/injuries due to either mechanical accidents or poisonings.

Figure 2-27 presents impact ratings of the effect on major communities in the study area resulting from major oil/gas field development. The impacts are measured against the community inventory developed in Chapter 4 of this section. Each community's rating reflects the impact of 240 people on a community's existing population base; and the present or near future sewage, housing, education, law enforcement, and water capabilities.

As an example, a community which has no excess capacity with respect to sewage treatment and whose current population level would be expanded by 30% as a result of an influx of 240 people would be assigned a Critically Sensitive rating. It should be noted that these ratings are based upon present (or near future) capacity to absorb additional population. These sensitivity ratings appear in the Map Overlay File and will be updated as conditions warrant.

South Dakota

Economic impacts from oil and gas activity in South Dakota are just beginning to be felt. During the period 1976 through 1977, the state experienced a 41% increase in the production of oil and the state's first natural gas field was reported. Nevertheless, total oil production in South Dakota for 1977 totaled only 632,000 barrels, far behind the 37.2 million barrels produced in Montana during the same year. Virtually all of the oil and gas activity to date in South Dakota has been confined to Harding, Stanley, Butte, and Perkins Counties, with Harding showing the greatest level of activity.

The lack of existing oil and gas activity and the apparent likelihood of future large scale development in the state precludes an analysis at this time of area specific economic and social impacts in South Dakota; however, because of the similarity of onshore oil and gas activities nationwide, general impact potential can be discussed.

Some of the smaller communities in South Dakota near future oil/gas field development may experience economic and social impacts if oil or gas workers choose to reside there during the relatively labor intensive development phase. These impacts would primarily be in the form of increased demand for housing and other goods and services including recreation. Additionally, some strain may occur on public services such as water, sewage treatment, health facilities, etc., if the population growth is large enough or if there exists little excess capacity in the public service system prior to population growth.

As additional drilling activity occurs in South Dakota, it will be possible to more accurately assess likely economic and social impacts. At that time, appropriate entries will be made in the Map Overlay File to reflect these developments.

Land Use

Oil and gas activities can have a significant impact upon land use. Generally, these impacts are centered in the communities nearest the area of activity. Small communities are heavily impacted since they generally are not prepared to cope with unexpected increases in population and associated demands for goods and services. Frequently, there is a lack of land use planning data necessary to provide for orderly community expansion. Consequently, lands could be developed with little or no long-range plans and without consideration for land use suitability. Often, there is a lack of land which is suitable for housing development. If land is available, subsequent development can change the character of the land which may or may not be compatible with surrounding uses.

By occupying the surface of the land, oil and gas companies can, in many instances, prevent or delay disposal of lands and subsequent transfer of ownership.

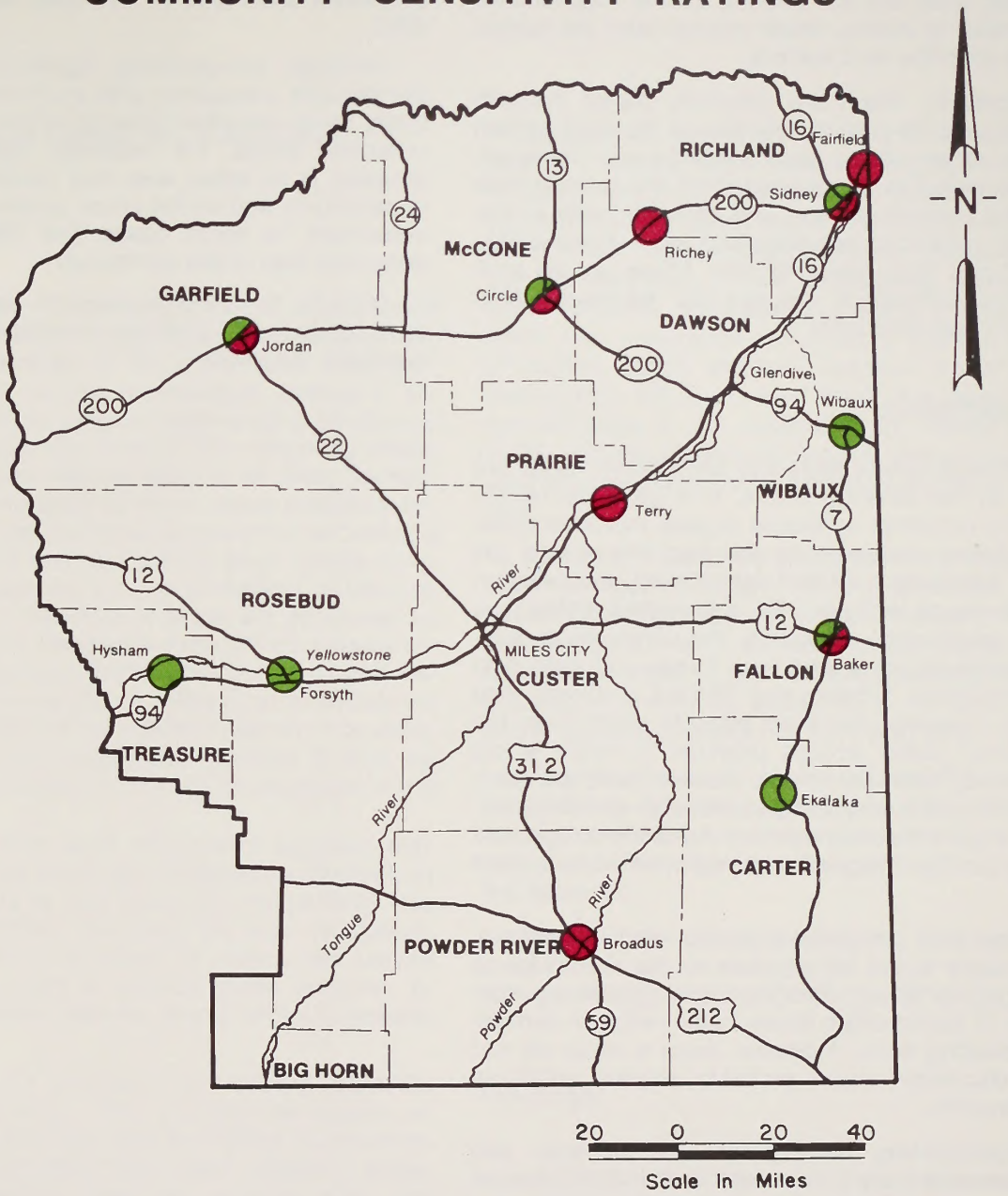
Although most of the communities within the District are surrounded by a sufficient amount of private lands to provide for additional expansion, there is a possibility some federal lands may be needed for this purpose in the future. Most likely, requests for federal land to be used for temporary housing sites or for townsites would only occur near a producing field in a remote location. The environmental impacts associated with such an action would depend upon the location and magnitude of the proposal and would have to be analyzed on a site specific basis.

Oil and gas activities cause surface disturbance by taking land out of forage or agricultural production. Even after the land has been cleared and the drill pad, pits, storage tanks and well have been constructed, the total amount of land encumbered is seldom more than 2 acres in size, with an average of less than 1 acre, excluding land taken for access and service roads.

Once a producing field is located, oil and gas activities generally require a network of powerlines and pipelines. Powerlines present visual distractions and take land out of forage production and preclude other uses. If a service road is constructed, 3-4 acres of land per mile are necessary to maintain the line. Service roads, depending upon

FIGURE 2–27

COMMUNITY SENSITIVITY RATINGS



LEGEND

- Sensitive
- Critically Sensitive

SOURCE: B.L.M., 1979.

existing soils and the amount of use they receive, can result in rutting, sheet erosion, and permanent scars upon the land surface.

Pipelines, which are generally buried beneath the ground, do not visually disrupt the land pattern to the extent above ground facilities do. However, soil erosion can be severe unless the existing soils are not properly packed and reseeded with a mixture of vegetative species which will become established in a short period of time. Above ground spillage and subsurface seepage can adversely affect downstream land uses.

Transportation

Although major highways and county roads are used to the extent possible, it is generally necessary to construct additional access roads to transport drilling equipment to and from the oil and gas area. Assuming a 48-foot right-of-way, approximately 6 acres of land per mile is impacted during new road construction. Obviously, the construction process removes some land from forage and agricultural production. Erosion and littering problems also result. However, the main impacts result from the additional public access provided to lands where previously there were none. Access roads are readily used by the recreating public who can detrimentally impact the environment before management plans can be designed and implemented to protect it.

New road construction is expected to increase, particularly in the Sidney area as the search for oil and gas continues. Existing access roads are adequate to accomodate future traffic needs in currently producing fields. However, even a minor oil and gas discovery would probably require additional construction.

Rights-of-way development for pipelines and transmission lines is expected to increase because of increasing per capita consumption of energy. This will require the linking of developed coal and oil and gas fields with market areas. (U.S. Dept. of Interior, 1975) In the past, petroleum accounted for the largest source of energy consumption in Montana. However, approximately 48 percent of Montana's petroleum is received from Canada and their current policy is a gradual curtailment of petroleum exports to the U.S. Once this action is taken, few alternatives exist to take up the slack of this cutback. The development of the proposed Northern Tier Pipeline would bring Alaskan crude oil to Montana refineries and would intersect a portion of the study area. If this project is developed, a large amount of federal land within the district may be involved. Without this project, it is expected that petroleum shortages in this area would occur by 1980.

Although transportation rights-of-way have all the impacts associated with environmental disturbance, there are other impacts which directly affect urbanized areas. For instance, right-of-way construction in an urban area may require the removal of structures and inhibit urban construction and development. In some cases, this may present an economic loss to the community.

Impacts to common carriers and freightlines from expanded oil and gas activities would be economically favorable.

2.3 MITIGATING MEASURES

Introduction

This chapter describes measures which would reduce or eliminate negative impacts resulting from oil and gas activity in the study area. The geographic scope of this assessment makes it extremely difficult to mitigate impacts on a site-by-site basis. Consequently, many of the mitigating measures which follow will not apply to all sites. Instead, these measures apply to those areas exhibiting environmental features that are Sensitive or Critically Sensitive to oil and gas activity (e.g., fragile soils, endangered species, etc.). In the Miles City District, stipulations at the time of lease are proposed by the appropriate Resource Area Office personnel. The district Surface Protection Specialist and Resource Specialists attach mitigation to individual leases at the time of the predrill inspection by utilizing the range of measures proposed in this Assessment necessary to protect the features found in the area.

In this section, each component suggests mitigating measures which are designed to eliminate or reduce impacts to that particular component. This range of protective measures will then be considered at the time of lease or during the predrill inspection in order to protect those sensitive or critically sensitive features found within a specific lease area.

Appendix 2-1 presents the existing BLM/GS stipulations package. This package represents efforts by these two agencies to develop a coordinated listing of the most often used mitigating measures to be used by these two agencies which are most directly involved with leasing of federal oil and gas resources. For that reason, the reader should note that Appendix 2-1 does not contain a complete listing of mitigating measures.

Special lease stipulations limit the lessee's normal enjoyment of the lease. Examples are when portions of the lease cannot be occupied or cannot be used during certain parts of the year for wildlife, watershed, or other reasons or when certain roads cannot be used, etc., or when special situations are evident at the time of lease issuance which will require unique or unusually expensive steps by the lessee. Special situations could involve extremely unstable formations, extremely high pressure water flows, or identified critical habitat for threatened or endangered species.

Stipulations for normal environmental situations such as access road location, design, and construction; construction materials; drill site and development facilities layout and construction; waste disposal; water supply; and protection or recovery of cultural resources, proper engineering techniques, visual resource considerations; steps necessary for quick and successful reclamation, wildlife habitat protection, facility location, required soil or water testing; etc., will be covered during the lease development stage in the Application for Permit to Drill (ADP) and the Multipount Surface Use and Operating Plan required by NTL #6 (see Chapter 1, Table 1-1).

Methods of seedbed preparation and seed mixtures can be left open until the time the actual rehabilitation operation is begun. However, where special species such as hard to find native seed, special seedings, or tree or shrub planting are anticipated, it should be stipulated at the time of approval of the Application for Permit to Drill.

The need for using special stipulations must be supported in this assessment or by including documentation with the recommendation for the stipulation's use. This documentation will be included in the lease file.

Some of the following mitigating measures are proper for use at the time of lease and others during the Application for Permit to Drill period.

Geology

Localities with known vertebrate paleontological sites should be protected by a No Occupancy stipulation. This can be covered in the special stipulations issued by the district Geologist or Surface Protection Specialist.

When vertebrate paleontological features are uncovered at any stage of oil and gas activity, they should be left intact and reported to the District Manager.

Areas having existing mines or mining permits should be avoided. This can be covered in the special stipulations issued by the district Geologist or Surface Protection Specialist.

Soils

Standard lease terms restrict oil and gas companies from causing or contributing unnecessarily to soil erosion, crop damage, forage and timber growth by taking reasonable steps to prevent damage. These terms also protects natural surface resources and improvements.

Restrict oil and gas exploration and drilling during muddy and/or wet periods to minimize soil and watershed damage in areas exhibiting high sensitivity to these activities. This limitation does not apply to maintenance and operation of producing wells.

Place seasonal restrictions for sensitive watershed and fragile soils.

Place limitations on occupancy, drilling and storage facilities, and time limits for activities. This will allow for reduced erosion by assigning slope restrictions and other pertinent information.

Construct roads with adequate specifications to insure proper grade and drainage. Culverts should be placed at appropriate locations to maintain existing stream channels.

Design development to conform to existing topography in order to minimize earthwork quantities.

Reduced soil compaction by vehicular traffic would be reduced by ripping, harrowing, plowing, discing or other mechanical means. Movements of water, air, and nutrients within the topsoil would be increased to near normal levels.

Minimize soil horizon mixing by stockpiling topsoil suitable material separate from less desirable material.

Following grading and construction, revegetate (with both ground cover and trees) the disturbed areas wherever such action would not interfere with the constructed facilities and their operation.

Use mulches and soil stabilizers where practicable and necessary to retard wind and water erosion until revegetation is established.

Grade storage tank areas so that drainage would be away from the tanks and toward drainageways to the holding basins to minimize effects of oil and fluid spills.

Locate pipeline routes and access roads to avoid areas of known low potential for rehabilitation or reclamation and slope failure.

Locate borrow pits and borrow areas away from roads and public use areas. Borrow areas should be stabilized and revegetated after use.

Stockpile and revegetate suitable topsoil material for later use in site rehabilitation. The depth of suitable topsoil will vary from site to site. Soil stockpiles should be protected from wind and water erosion.

Line waste pits, reservoirs and mud pits, if located in permeable soils, to prevent mud and toxic materials from entering soils and water tables. Reserve and waste pits help reduce spills and contain drilling muds and formation fluids.

Channel sediment from water erosion to holding basins for retention and treatment prior to release into the watershed.

Vegetation

Follow state standards for plugging seismograph shot holes and enforcing personnel safety.

Continue use of strict stipulations restricting the use of bulldozers in seismograph operations.

Locate well sites, tank batteries, reserve and mud pits far enough away from drainages to preclude contamination of watershed.

Allow temporary roads to be constructed for only the minimum width needed and avoid deep vertical cuts and steep long fill slopes.

Construct dikes around all facilities that generate or store contaminants.

Maintain, in a serviceable and safe condition, all improvements, including fences, gates, cattleguards, roads, trails, pipelines, bridges, water developments, and control structures.

Do not discard contaminated water or other toxic material into streams or on the ground surface.

Line reserve pits to prevent contamination of ground water or soil in areas where needed, depending upon soil and watershed characteristics.

Install waterbars, terraces, or diversion ditches on the uphill sides of facilities to control runoff water in areas where needed, depending upon slope and watershed values.

Limit, by adequate advance planning, the number and dimensions of pipelines, test wells, and camp facilities and take advantage of road locations to minimize surface disturbance.

Require rehabilitation by methods which include revegetation with adaptable ground cover species, installation of mechanical or other erosion control devices, removal of foreign material, scarification of sites with compacted soils, bed preparation, mulching, fertilizing, irrigation, planting, and protecting fencing.

Fence and flag mud, separation pits, and other hazardous materials to prevent access to humans, livestock, waterfowl, and wildlife.

Require contingency plans from operators for controlling spills or leaks.

Notify the BLM grazing lessee or permittee of the approximate starting and completion dates for oil and gas activities.

Avoid range study plot areas to prevent the possibility of destruction.

Water

Require examination by district personnel of geophysical lines both before and after completion (e.g., overflights or on-the-ground examination).

In areas where the slope is greater than 20%, the district soil scientist will examine the route and make appropriate recommendation prior to geophysical work.

In areas where a geophysical line is to cross an ephemeral stream channel with a drainage greater than 10 square miles above the proposed crossing, the district hydrologist will examine the route and make appropriate recommendations. In all cases, reasonable attempts should be made to minimize drainage crossings.

Any earth disturbing activities within 500 feet of the Missouri, Yellowstone, Tongue, Grand, Moreau, Cheyenne, Bell Fourche, Musselshell, or White Rivers should be examined by the district Soil Scientist (and Hydrologist in special cases) and appropriate recommendation made.

Do not allow the detonation of explosives used in geophysical exploration within 1/8 mile (422 feet) of any well or spring.

Continue on-the-ground examination by BLM personnel of all drill pads and access roads before and after completion.

Require adequate size culverts or other devices (able to handle a 50-year runoff event) with necessary energy dissipation devices installed at major drainage crossings. In areas with clayey soils, low water crossings may be preferable since culverts are difficult to retain in these soils types.

Require, where necessary, temporary stream stability structures especially where access roads cross stream channels and along steep (greater than 30%) cutbanks and fill slopes upon the recommendation of the district soil scientist and hydrologist.

Do not allow occupancy upon the (100-year) floodplain of the Missouri, Yellowstone, Tongue, Musselshell, Grand, Moreau, Belle Fourche, Cheyenne, and White Rivers in cases where there are significant risks to property, human safety, water quality or significant degradation to the riparian environment.

Require that occupancy of any other (100-year) floodplain be examined and appropriate recommendations made such as the containing of drilling mud in tanks, the construction of flood retention dikes, and placement of hazardous materials out of the floodplain. (Refer to Figure 2-10 for Sensitive areas.)

Allow no earthmoving work within 300 feet of ephemeral stream channels with a drainage area of greater than 10 square miles (6,400 acres) and all perennial stream channels without the approval of the district manager with appropriate recommendations from the district soil scientist, hydrologist, and fisheries biologist.

Require stream stability structures at all stream crossings by permanent roads where drainage areas are greater than 10 square miles (6,400 acres).

Limit earthmoving work to areas where slopes are less than 20% wherever feasible.

Revegetate all disturbed areas as soon as possible.

Require that all evaporation ponds be diked and not subject to runoff from drainages. Dike and fill should be compacted subsequent to dozer work. One-half of the pond structure should be cut into original ground level.

Encourage that mud pit fluids be pumped from the pit and rehabilitation take place as soon as possible. Require such measures in cases where pit site could affect perennial water courses. This would depend upon the site's soil and drainage characteristics.

BLM should maintain minimum emergency oil spill control equipment and should give employees training in its use. Portions of the Oil Spill Contingency Plan (1978) developed by the California State Office of BLM could serve as a guide for development of such a Plan by the Montana State Office.

Animals

Allow No Occupancy within 1/2 mile of lands designated as critically sensitive endangered species habitat. The Endangered Species Act (1973) forbids damages to critical habitat which would

jeopardize the existence of the endangered species. This would include the black-footed ferret habitat, peregrine falcon eyries, and active bald eagle nests and wintering areas found in the District (Endangered Species Act, 1973). The bald and golden eagles are further protected by the Bald Eagle Protection Act preventing the "taking" of eagles. The term "take" refers also to pursuit, shooting, poisoning, wounding, killing, capturing, trapping, collecting, molesting, or disturbing (Bald Eagle Protection Act 1973, Sec. 668C).

Allow No Occupancy on sites designated as critically sensitive sharptail grouse breeding arenas and sage grouse arenas or wintering areas.

Do not allow oil and gas activities within 1/2 mile of a grouse breeding ground during the period from March 15 to June 15 to minimize disturbance to ground during breeding season.

Allow No Occupancy on the area designated as critically bighorn sheep range.

Allow No Occupancy in those areas designated as critically big game winter concentration areas.

Allow no exploratory or development activity between December and March on areas designated as big game winter range.

Allow No Occupancy within designated prairie dog town boundaries.

Allow No Occupancy within 500 feet of critically sensitive waterfowl nesting areas.

Allow no oil and gas activities within 100 feet of areas designated as critically sensitive riparian habitat.

Require a Field Development Plan including a plan for the road system in an oil field production area to avoid a major portion of the effects of vegetative loss due to road construction and the consequent effects upon wildlife. Under the plan, one major road through the field with adequate (depending upon truck size) spur roads to well sites (Figure 2-28) would eliminate the haphazard maze of roads and trails through the field. This would reduce the acreage of vegetation lost and, consequently, would provide more forage for wildlife.

To prevent wildlife from using the toxic water contained in the reserve pits, federal leasing could require these pits to be fenced and covered with lightweight netting until they are emptied. To further prevent contamination, the reserve pits could be lined with bentonite to inhibit salts and other toxic materials from seeping into the surrounding terrain and drainages. In open soils and high ground water areas, require reserve pit lining or containment tanks when necessary.

In the production stage of oil and gas development, the operator usually inspects each well site daily. During the months of January and February, a critical period for many wildlife species, the operator's activity could be limited to the hours of 9 a.m. to 3 p.m. in general big game winter range areas.

Install cattleguards on all permanently constructed roads to prevent livestock crossing to other pastures.

When necessary drill sites could be diked around the perimeter of the entire pad. Then, in the event of a blowout or other problems resulting in spills, the liquid would be channeled to the reserve pit preventing or reducing contamination of drainages and the surrounding vegetation.

During wet periods of the year, roads to exploratory drill sites should be periodically graded to remain passable. This would eliminate much of the off-road travel that occurs around drill sites, resulting in less surface disturbance.

A large portion of the study area is without a complete intensive wildlife inventory and, consequently, many critically sensitive habitats have not been identified. Should these areas be leased and development occur, the proposed mitigations by the aforementioned stipulations would not be effective. It is therefore important as a mitigating measure that these critical areas be identified as expediently as possible.

Recreation

Allow no surface occupancy in any of the existing developed recreation sites.

Companies could develop additional recreation sites for use by employees.

Companies could provide funding to city and county programs to provide additional recreation programs for employees during development and production phases.

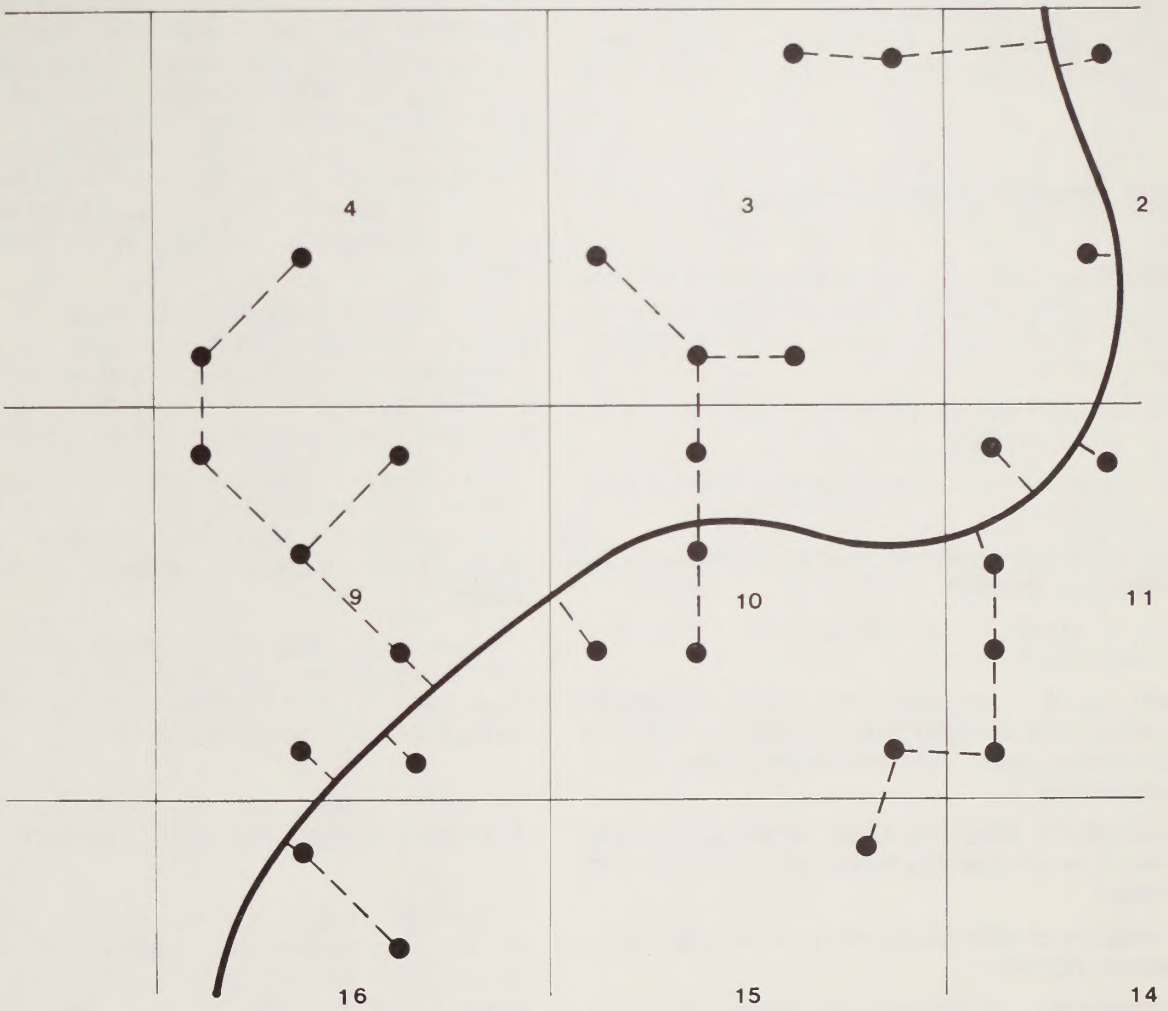
Require setbacks from existing recreation sites and/or restrict road use during high recreation use periods.

Wilderness

Allow no surface occupancy on any portion of a lease in a Wilderness Study Area (WSA) or intensive inventory unit until Congress acts on the WSA or until the inventory unit is dropped from the wilderness review process.

FIGURE 2—28

PROPOSED OIL FIELD ACCESS LAYOUT



LEGEND

- Spur road with borrow pits
- Secondary road
- Well Site

SOURCE: Miles City District B.L.M., 1979.

Do not issue new leases in WSAs or intensive inventory units until those units are either approved or rejected for wilderness status.

Apply strict landscaping and other controls to drilling and/or exploration activities on locations immediately adjacent to WSAs and inventory units which would reduce the visual presence of these activities.

Visual Resource Management

Design and planning and of all activities for new facilities should consider long-term rehabilitation in deference to short-term visual impacts. Design and planning criteria shall include:

1. Use of flatter slopes rather than steep slopes for all grading activity
2. Avoidance of treed areas and use of vegetation for screening
3. Use of natural breaks in vegetation for road and utility construction
4. Use of natural topographic breaks for road and utility construction
5. Joint use of access roads and strict limitations of vehicle use on other than established roads by operators during field development and recovery phases
6. Avoidance of hard rock areas, where possible, to eliminate unreparable headwalls or reduce their height
7. Avoidance of side hill locations for access roads where possible
8. Construction of slopes not steeper than 3:1 where this does not make long-term rehabilitation more costly
9. Use of native plant materials for rehabilitation and use of the types of vegetation (extent on the site before construction)
10. Use of rehabilitation techniques compatible with future use of the area

Approval by the District Manager of all plans and designs shall be required. Information contained therein shall be mutually satisfactory to the District Manager, BLM, and local representatives of USGS in portrayal of site conditions and prognosis for successful rehabilitation. The lessee shall be required to provide all required additional information at his own expense before the permit shall be processed, shall modify plans and designs to the satisfaction of the District Manager, and shall provide adequate lead time for the processing of permits.

Structures in areas of rustic or pastorale character as determined by the District Manager shall be free from clutter and painted in earth tones. The colors shall not necessarily blend with the natural or pastorale landscape but should present a well maintained and clean appearance. Drab grey and dark green should be avoided. Colors shall be approved by the District Manager where not specified by the Occupational Safety and Health Administration. I11Structures in landscapes determined by the Distrct Manager to be "natural" shall be painted with colors approximating the natural summer color of the landscape as approved by the District Manager.

All facilities shall be kept clear of unsightly debris and refuse and all remnants of resource development, save a witness post where required, shall be removed on or before the termination of the lease to the satisfaction of the District Manager.

Except where construction is designed for permanent or future land use, the contour of the natural landscape shall be restored or graded to a natural appearing slope to the satisfaction of the District Manager.

Plans and designs for roads, pipelines, and major construction sites shall be prepared under the supervision of a registered Civil Engineer and/or registered Landscape Architect.

Prehistoric and Historic Features

Through Section 2.Q, standard on all oil and gas lease agreements, and a cultural resource stipulation (MSO 3100-47) attached to all oil and gas leases issued from the Montana State Office, the oil and gas companies are committed to complying with cultural resource related legislation, including the Antiquities Act of 1906, National Historic Preservation Act of 1966, National Environmental Protection Act of 1969, Archaeological and Historic Preservation Act of 1974, and Federal Land Policy and Management Act of 1976. This also entails a commitment to satisfy 36 CFR 60 and 36 CFR 800, regulations to enforce the National Historic Preservation Act of 1966.

The Montana State Office standard stipulation, MSO 3100-47 (see Appendix 2-1), requires the area of operation to be inventoried for prehistoric and historic features. The features inventoried should be described in a report, and appropriate mitigating measures applied. It further requires operations to be halted if previously undiscovered cultural remains are found as part of oil and gas operations, until appropriate action has been taken by the District Engineer, U.S. Geological Survey.

In Nonsensitive areas, it is presumed that inventory has taken place and reporting has shown no surface indication of prehistoric or historic features. The applicant can then proceed with operations, exercising caution to observe previously unreported cultural resources and halting ground disturbance when any such materials are found.

Sensitive areas have also been completely or partially inventoried and prehistoric or historic features are known within the cadastral section where lease activities are proposed. Stipulation MSO 3100-47 should be added to the lease as well as appropriate detailed mitigating measures. This would probably entail further inventory, avoidance of the site areas, or excavation of a site to recover the data it contains (after compliance with 36 CFR 800 if necessary, as shown in Appendix 2-2). If previously unknown features are found by the operator, ground disturbance should be halted, identical to the Non-Sensitive area discussion above.

Avoid Critically Sensitive areas since they cannot be mitigated, except by avoidance or extensive excavation which may take many months. If the operator is not able to avoid a Critically Sensitive site, measures to fully comply with 36 CFR 800 must be taken (Appendix 2-2). Criteria for determining eligibility for the National Register of Historic Places must be applied. If the site is determined eligible by the Keeper of the National Register, the State Historic Preservation Officer consulted, and the Advisory Council on Historic Preservation comments that the oil and gas operation has an adverse effect, the decision rests with the BLM District Manager. The District Manager can, upon the advice of the Advisory Council on Historic Preservation, require the applicant (operator) to avoid the area containing the site.

Areas which Require Further Study are unknowns, having had no inventory for prehistoric and historic features. This classification does not prevent leasing, but requires the applicant to follow all sections of MSO 3100-47: inventory, reporting, and mitigation of impacts to prehistoric or historic features. Mitigation could follow three paths in following compliance with 35 CFR 800: (1) if cultural resources are found to be present in the area of proposed operations, the applicant would be asked to move his operation to avoid the site; (2) if the site was found to be Critically Sensitive, and the applicant could not move his operations, it would then be treated as explained above under Critically Sensitive; and (3) if the operator does not move his operation, and the site can be mitigated by recovery of data, the operator would be required to excavate or remove the components of the site. Previously unknown features encountered during oil and gas operations would be treated as explained in the discussion of Nonsensitive areas.

Economic and Social Conditions

The primary impacts would be within communities which are called upon to provide services and housing to incoming oil/gas workers. The main impacts would be a shortage of housing and public services (e.g., water, sewage treatment, recreational facilities) needed to accommodate the population influx associated with nearby development of a major oil/gas field. Consequently, mitigation of these impacts would center around reducing the total population influx by hiring local labor whenever possible and by providing some services by the oil/gas development company whenever practicable. The following measures would, if implemented, reduce these impacts in direct proportion to the degree to which they are implemented:

Basic training of local labor by the oil/gas companies to reduce population influx.

Company sponsored temporary housing in the form of bunkhouses or trailer pads/hookups. This could be combined with appropriate incentives to insure that these units are utilized (e.g., bus service provided by the oil/gas companies on weekends to retail/trade and recreation centers).

Company sponsored physical and mental health care for workers.

Company sponsored training concerning the dangers of hydrogen sulfide. This should include oil and gas workers as well as residents of areas where hydrogen sulfide is expected to be a problem.

Land Use

The lessee must keep the lands open at all reasonable times for the inspecton of any duly authorized officer of the Department.

The lessee must exercise reasonable diligence in drilling and producing the wells and have due regard for the prevention of waste of oil or gas and for the preservation and conservation of the property for future productive operations.

The lessee agrees to take such reasonable steps as may be needed to prevent operations on the leased lands from unnecessarily: (l) Causing or contributing to soil erosion or damaging crops, including forage and timber growth thereon or on federal or non-federal lands in the vicinity; (2) polluting air and water; (3) damaging improvements owned by the United States or other parties or (4) destroying, damaging, or removing historic or prehistoric ruins or other cultural material. Upon any parties total relinquishment, cancellation or expira-

tion of the lease and to the extent deemed necessary by the lessor, the lessee is required to fill any pits, ditches, and other excavations, remove or cover all debris, and so far as reasonably possible, restore the surface of the leased land and access roads to their former condition, including the removal of structures as and if required. The lessor may prescribe the steps to be taken and restoration to be made with respect to the leased lands and improvements thereon whether or not owned by the United States.

The lessor reserves the right to permit for joint or several use easements or rights-of-way, including easements in tunnels upon, through, or in the lands leased, occupied, or used as may be necessary or appropriate to the working of the same or of other lands containing deposits described in the act, and the treatment and shipment of products thereof by or under authority of the Government, its lessees or permittees, and for other public purposes.

The lessor reserves the right to lease, sell, or otherwise dispose of the surface of the leased lands under existing law or laws hereafter enacted, insofar as said surface is not necessary for the use of the lessee in the extraction and removal of the oil and gas therein, or to dispose of any resource in such lands which will not unreasonably interfere with operations under the lease.

2.4 RESIDUAL ADVERSE IMPACTS

Introduction

This section discusses likely adverse impacts remaining from section 2.2, Environmental Impact Assessment, after application of the measures discussed in section 2.3, Mitigation.

Geology

No residual adverse impacts are expected.

Soils

Even under the most careful management, some soil areas may be difficult to reclaim, especially if pipelines, pads or other construction activities will be placed on Sensitive and Critically Sensitive soils.

Oil and gas activities would have residual adverse impacts on soils with slopes of over 15%. Extensive cuts and fills would be needed on steep slopes. These impacts may not be mitigated where steeper slopes are combined with highly erosive soils in Sensitive or Critically Sensitive categories.

Removal of buildings, storage tanks and other facilities during abandonment could result in impacts as great as those during initial installation. Fill material would replace soil that was surplus during construction. Soil fill removal impacts would occur at the location the new fill material was obtained.

An accident leading to an oil spill could cause significant and irretrievable loss of soil productivity for several years. However, with time and careful rehabilitative efforts, soil productivity might be reestablished. Some loss of soil productivity would occur as a result of construction. Total loss would be proportional to acreage occupied by tanks, holding basins, buildings, roads, and parking lots.

It is likely that some soil erosion would continue on disturbed sites. Rehabilitated areas and resultant soil profiles would not conform to original soil series characteristics, resulting in the loss of natural soils in that area.

Vegetation

Existing vegetation would be eliminated from all acreage directly disturbed by construction of well locations and access roads at an estimated average of four acres (well site plus roads) for each well drilled. The disturbed acreage would be replaced primarily with grass communities within a few years following post-drilling rehabilitation. Disturbed sites from which ponderosa pine trees were removed would not likely be capable of tree regeneration for several decades, if ever.

Water

Any surface disturbance would result in increased erosion and sediment yield. It is reasonable, however, to expect that erosion and sediment yield would be reduced substantially with vigorous enforcement of the mitigating measures. Erosion and sediment yield would continue above normal until disturbed areas have been rehabilitated to their approximate original percent ground cover and contours.

System failures such as oil spills, leaks, and reserve pit failure provide the greatest opportunity for impacts to the water resource. Present safety regulations and stipulations greatly reduce the number and severity of such accidents.

Animals

The greatest potential impacts on wildlife would likely occur on large producing oil and gas fields. Surface disturbance would occur from road construction maintenance, and site development. Direct disturbance at maximum field development would likely never exceed 10% of the surface acreage of a given section of land; however, large expanses of habitat would be restricted or unavailable for wildlife use in the event of intensive oil and gas activity.

In a large field, the amount of habitat (food and cover) lost would be substantial. Individual animals, especially small mammals, reptiles and amphibians would be lost during construction and some avian

nests could be destroyed. The continuous vehicle and human activity during all but the abandonment stage of oil and gas development would cause many animals to leave the affected area. Those species that are intolerable of this much activity would not use the area until the field was abandoned.

After all precautions are taken to prevent accidents, blowouts and oil spills could still occur. In these incidents, plants and animals in the immediate range of the spill would be lost. Further impacts would occur if the toxic liquid reaches a drainage. The resulting impacts would depend upon how soon the spill is discovered and how effectively the material is recovered.

The greatest impacts on livestock would also occur on large producing oil and gas fields. The reduction of available forage from construction of roads and pad sites would result in less livestock production in those areas. If the stipulations are adhered to, however, the impacts on livestock will be minimal.

Recreation

Residual impacts would be the same as those outlined in section 2.2, Environmental Impact Assessment. Facilities, both urban and outdoor, could remain below acceptable maintenance levels brought on by over use and vandalism. Assuming funds to restore these facilities are not available, the resident population would suffer a loss in the perceived quality of their recreation experiences. Development and production activity could adversely affect the numbers of game animals in an area, reducing the value of a hunting experience or of other outdoor recreational pursuits.

Wilderness

Any oil and gas drilling or exploration adjacent to WSAs or intensive inventory units would reduce the opportunity for solitude and lower the natural appearance of the general area.

Visual Resource Management

The visibility of visual change due to oil and gas activity would be reduced to an acceptable level; that is, the contrast of the activity with the landscape would be within VRM objectives, with the regrowth of vegetation except where slopes have not been returned to a natural appearing form. Some areas of poor vegetative regrowth can be anticipated in areas with bentonite "scabland" soils and on steep headwalls. The clay strata of badlands and irregular forms of the breaks area cannot be restored; however, these changes would not be noticeable as fresh erosion increases the variation in constructed slopes duplicating their natural appearance.

Where poor response to rehabilitation of sites occurs, a visual impact will follow, except where erosive forms are the norm.

Prehistoric and Historic Features

The major residual adverse impacts would be to those Critically Sensitive sites experiencing oil and gas operations. The nature of these sites is such that they have potential visitor-use importance and/or they are difficult to mitigate by data recovery. Damage or destruction to these sites would be a major impact which could not be mitigated.

Where features and sites are not avoided, and the sites are excavated, information would be gained on those sites which would be beneficial. However, the sites could not be studied later with improved archaeological methods, thus creating a partial residual adverse effect.

Economic and Social Conditions

A certain level of population influx would be inevitable if major field development occurred. For this reason, a community close to major field development will almost certainly experience some strain on public services as a result of population growth. Because the exact level of development and level of implementation of mitigating measures are unknown at this time, it is impossible to quantify the level of residual adverse economic and social impacts by locality.

Land Use

If the lands associated with oil and gas activity are reclaimed they will, in time, become reestablished with native vegetation. However, the length of time required for the lands to develop the production capability they had previous to oil and gas development is so great (many decades to centuries) that this impact is considered a long-term residual impact.

Depending upon the number of developed wells in a given area, unreclaimed lands could result in a substantial loss in land productivity. For instance, existing regulations allow the development of one oil well for every 40 acres of land and one gas well for every 160 acres of land. If it is assumed that an average drilling site, including wells, pads, storage tanks, service roads, etc., will disturb an estimated 3 acres of land surface, then, at maximum development, the amount of productive land lost to oil development would likely approximate 48 acres per square mile (7 1/2% of 640 acres), or about 22 acres per square mile (3 1/2% of 640 acres) for lands developed for gas production.

CHAPTER 3

CHAPTER 3

INTRODUCTION

Chapter 3 addresses potential impacts upon the region and nation as a result of the No Action alternative. The structure of BLM's oil and gas leasing program allows the discontinuation of leasing for appropriate reasons but does not provide for the setting of arbitrary production/leasing levels of federally administered oil and gas resources. Accelerated or decelerated leasing levels are not analyzed, but would result in graduated levels of impacts in comparison to those discussed.

The No Action alternative assumes that the Secretary of the Interior exercises his authority to discontinue leasing of federal oil and gas in Montana and the Dakotas. The effect of this alternative on regional and national supplies of fossil fuels and on the physical and human environment is addressed. It should be noted that although implementation of this alternative is unlikely, oil and gas leasing by BLM is discretionary and as such could be halted altogether if adequate justification exists.

The discontinuation of BLM's Montana State Office oil and gas leasing program would result in the curtailment of future production of federal oil and gas resources. Immediate impacts would be: (1) a loss of these two fossil fuel sources to the state and nation; (2) direct loss of employment and income for those oil and gas workers associated with the exploration, development, and production of federal oil and gas resources; (3) loss of economic production due to elimination of this energy source; (4) indirect (secondary) losses in employment and income; (5) loss of federal oil and gas bonuses, rents, royalties, and filing fees; and (6) elimination of future surface disturbance on lands overlying federal oil and gas resources as a result of leasing.

The following analysis discusses, by environmental component, the implications of discontinuing federal oil and gas leasing in the Miles City District.

GEOLOGY

The impact to the geology resulting from the No Action alternative could be a greater dependence on coal to make up the energy resource loss.

SOILS

Impacts on existing, unexpired lease holdings would be identical to those described in Chapter 2. It is likely that increased activity on unexpired federal leases could lead to greater soil related impacts than are now occurring. Impacts from geophysical operations would continue.

VEGETATION

With this alternative, drilling would continue for an unknown period on existing producing leases--perhaps for 20 years or more. Also, vegetation impacts would likely increase on surface underlain by private minerals. Impacts from geophysical explora-

WATER

This alternative could initially have an increased adverse impact upon the water resource. Exploration activities would increase on existing leases in an attempt to discover oil and gas before the leases expired. The impacts associated with preliminary exploration, exploratory drilling, and development discussed in Chapter 2 are likely to increase substantially or at least become more concentrated prior to lease expiration.

Over a period of 8 to 10 years, exploration activity on existing federal lease holdings would decline. Eventually, after all existing leases expired, there would be no new impacts from exploration or development on lands over federal oil and gas subsurface. Impacts from production would continue until existing oil and gas fields were abandoned. Hydrologic impacts from geophysical activity would continue in the absence of federal leasing.

tion would continue even in the absence of federal leasing.

ANIMALS

Discontinuing federal oil and gas leasing would create impacts comparable to those discussed in Chapter 2, Environmental Impact Assessment, but at a smaller scale. Existing leases would be developed more rapidly and the impacts would continue until abandonment. The impacts of oil and gas leasing would continue, however, assuming that mineral leasing and development occurred (possibly at an accelerated pace) on private and state surface. Many species of wildlife are mobile creatures and, consequently, a private oil and gas production area adjacent to public lands would affect those species in the general area.

If leasing does not occur, there will be no effects upon the livestock using lands overlying federal oil and gas estates.

RECREATION

If federal leasing does not occur, there would be no impacts on recreation beyond those associated with normal population growth.

WILDERNESS

This alternative would have a beneficial impact on wilderness values by removing the potential for disturbing the solitude and naturalness of the area.

VISUAL RESOURCE MANAGEMENT

Where small parcels of land overlying federal oil and gas domain are not leased within areas of non-federal intensive oil and gas activity, a contrast between those parcels and the developed area would occur. This contrast would be virtually unnoticeable because of the character of oil and gas fields and the dispersion of unaffected areas within a developed field. For these small parcels, the non-leasing of federal oil and gas subsurface would have a negligible affect on the appearance of the area as a whole.

Where larger blocks of lands overlying federal subsurface occur, the affect of non-leasing would be a lack of change in the visual surface of the land except where public lands abut developed private lands. The affect of adjacent lands on overlying federal oil and gas subsurface would be negative; the affect on public lands of other character would be neutral.

PREHISTORIC AND HISTORIC FEATURES

The only impacts to cultural features anticipated in the absence of federal leasing are those identified in Chapter 2 concerning geophysical exploration. These would occur since geophysical operations would continue even in the absence of federal leasing.

ECONOMIC AND SOCIAL CONDITIONS

Discontinued leasing of federally owned oil and gas resources in the Miles City District would result in an annual loss of 30.31 trillion Btu's of fossil fuel energy (1.69 trillion Btu's of gas and 28.62 trillion Btu's of oil, based on FY 1978 production data).

Because of the close relationship between energy consumption and economic activity (Appendix 3-1), this energy loss would either result in a reduction of the United States' gross national product, an increase in energy impacts, an increase in the use of alternate fuels such as coal and nuclear energy, or an increase in petroleum imports. Past relationships between energy consumption and gross national product in the United States indicate that approximately 73,000 Btu's are required for every dollar of gross national product. Based upon a linear relationship between gross national product and energy consumption, it is likely that the United States' gross national product could be reduced by $415.19 million as a result of the loss of 30.31 trillion Btu's of petroleum and natural gas energy (if not replaced by other energy sources). This loss would represent a reduction of .02% in the nation's 1977 gross national product. Using recent gross national product to jobs coefficients, this could mean a loss of approximately 3,700 jobs nationwide (roughly .24% of total 1977 national employment).

There could be a loss of jobs locally resulting from curtailment of federal oil and gas leasing activities. Assuming that recent production levels on government oil and gas leases would continue into the future, it is estimated that approximately 146 jobs could be lost in the Miles City District as a result of discontinuation of federal oil and gas leasing (see Appendix 3-2 and 3-3, respectively, for GNP and job loss estimation methodology). In addition, there would be secondary (i.e., indirect) employment losses in the Miles City District and elsewhere if the estimated 146 direct jobs and associated annual payroll of approximately $2,628,000 (146 x $18,000) are lost. The U.S. Treasury and the State of Montana would lose $8.7 million per year in bonuses, royalties, and rentals (FY 1978 data) from the Miles City District if past levels of federal oil and gas activity are precluded in the future as a result of this alternative.

The State of Montana currently assesses a severance tax on oil and gas operators. The rate is 2.65% of gross value on natural gas and 2.65% of gross value of oil in excess of $6,000 (2.1% on oil of less than $6,000 gross value). If federal oil and gas production were eliminated in the Miles City District, this would result in a loss to the State of Montana of approximately $1,143,072 annually in oil severance tax revenue and $10,900 in natural gas severance tax revenue (1978 data).

It should be understood that these estimates are based upon the most recent data available (1977 or 1978), and upon the assumption that non-federal oil and gas activity would not change as a result of this alternative.

LAND USE

This alternative would mean that BLM lands would be available for other public purpose uses such as agriculture and livestock production, wildlife, and recreational uses. However, no leasing by the federal government could affect leasing on private lands in cases where subsurface is necessary for efficient exploration and development activities.

Discontinuing oil and gas leasing on public lands would not significantly affect the Bureau's policy of granting rights-of-way for energy related purposes. Providing the companies could comply with the necessary mitigation designed to protect public resource values, rights-of-way for transportation and access would continue to be granted on a frequent basis; however, the demand for rights-of-way and ancillary uses would be lessened under a no-leasing policy.

CHAPTER 4

CHAPTER 4

INTRODUCTION

This section describes, by environmental component, the physical, biological, and cultural features within the study area. Particular emphasis is placed on describing those features which are expected to experience impacts from oil and gas activity.

GEOLOGY

Stratigraphy

The Miles City District lies within the Missouri Plateau section of the Great Plains Physiographic Province. Exposed strata range from Precambrian rocks to Recent alluvial deposits. Formation names may differ occasionally between Montana and South Dakota. The legends accompanying the geologic map (Figure 4-1) and the stratigraphic correlation chart (Figure 4-2) depict equivalent units by the overlapping of formation boundaries.

Precambrian Through Cretaceous Systems

The Black Hills Uplift, centered in western South Dakota, has exposed a Central Precambrian core surrounded by a nearly complete sequence of later sedimentary rocks. Highly metamorphosed and intensely folded strata make up the greater portion of the Precambrian nucleus. The flanks of the uplift consist of marine Paleozoic and a combination of non-marine and marine Mesozoic rocks. Formations decrease in age moving away from the Precambrian core.

Upper Cretaceous Pierre Shale, Fox Hills Sandstone, and Hell Creek Formation occupy most of the surface area in South Dakota. The Pierre Shale correlates to the Montana Group (Bearpaw Shale, Judith River Formation, etc.) located in the northwestern portion of the study area. The Fox Hills Sandstone and the Hell Creek Formation are also exposed in the northwest along the flanks of the Cedar Creek Anticline and in places along the Missouri River drainage.

Tertiary System

The non-marine Paleocene Fort Union Formation underlies most of the western portion of the district. In Montana, the formation consists of (in ascending order) the Tullock, Lebo Shale, Tongue River, and Sentinel Butte Members. Moving east into the Dakotas, the Tullock and Lebo Shale Members are combined into the equivalent Ludlow Member. The Cannonball Member occurs only in the Dakotas and, unlike other members of the Fort Union Formation, is of marine origin.

A substantial portion of south-central South Dakota is underlain by the Oligocene White River Group and the Miocene Arikaree Formation. The development of badland type topography is common in the White River Group.

The youngest Tertiary deposit in the area is the Pliocene Flaxville Formation. The formation consists primarily of river deposited gravels that form plateaus or benches in eastern Montana. The only intrusive rocks that are exposed in the district are of Precambrian and Eocene age and are confined to the Black Hills area.

Quaternary System

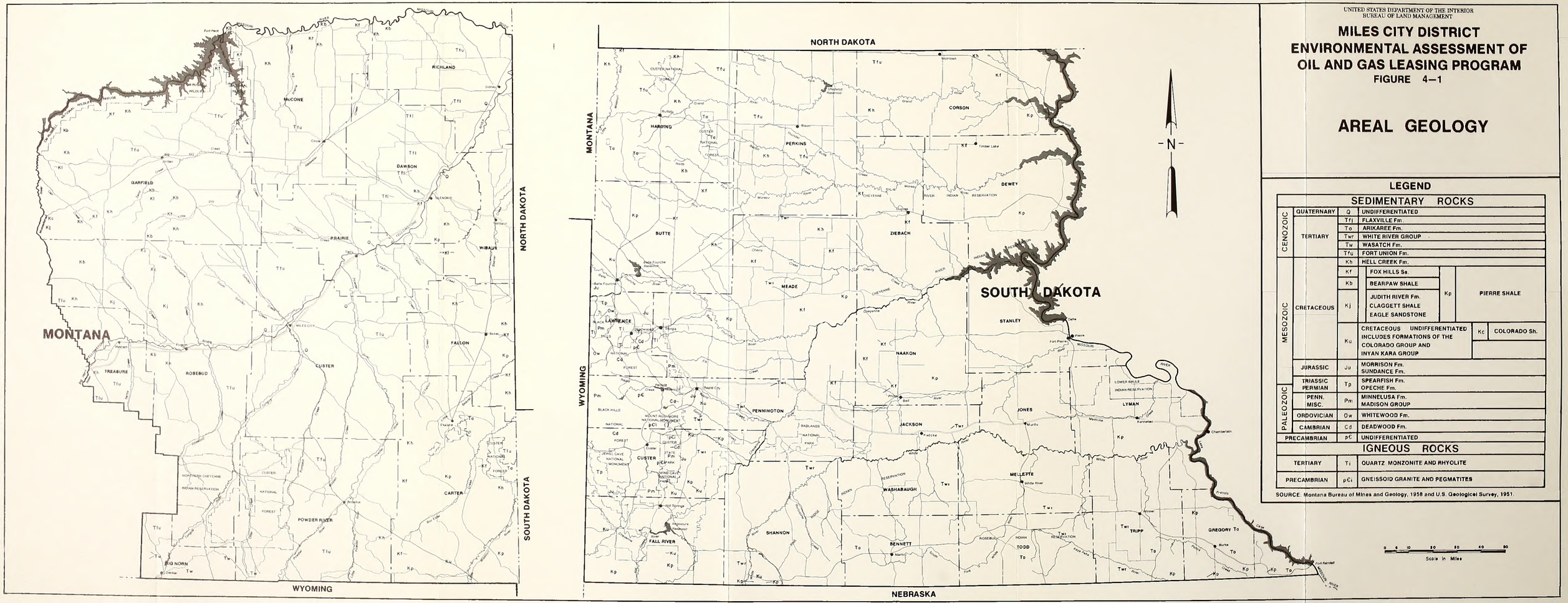
Remnants of glacial debris form a thin veneer over some of the plateaus and along some drainages in northeastern Montana and eastern South Dakota. Alluvial deposits of silt, sand, and gravel cover the floodplains of all the major streams and most of their larger tributaries.

Structure

Basically, the study area is a large structural basin having relatively flat-lying strata that contain isolated areas of uplift and folding. Except for the Black Hills, most areas have a total structural relief of only a few hundred feet. Figure 4-3 depicts the general relationship of the major structural features of eastern Montana and western South Dakota.

Williston Basin

This is the largest structural feature in the District. The basin is centered near Williston, North Dakota, and extends into Montana, South Dakota, and Canada. Subsidence of the basin began in



UNITED STATES DEPARTMENT OF THE INTERIOR
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MILES CITY DISTRICT ENVIRONMENTAL ASSESSMENT OF OIL AND GAS LEASING PROGRAM

FIGURE 4–1

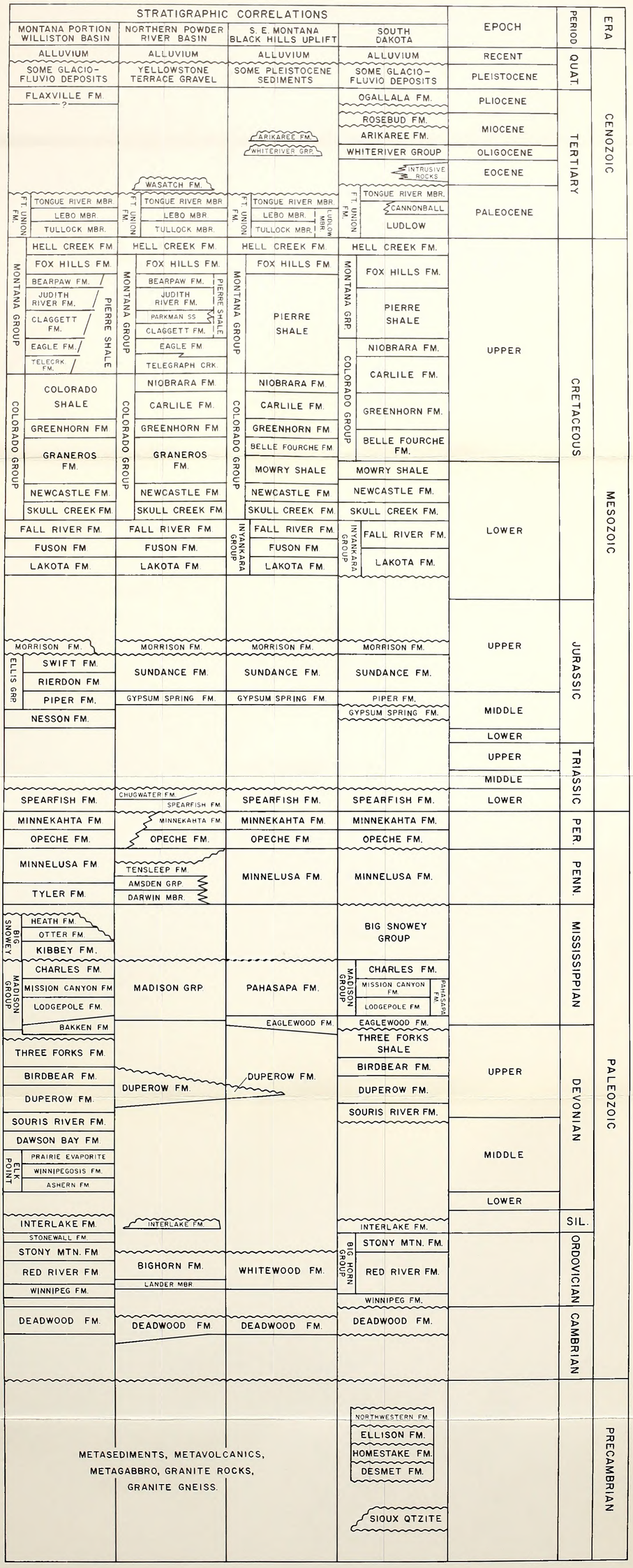
AREAL GEOLOGY

LEGEND

SEDIMENTARY ROCKS						
CENOZOIC	QUATERNARY	Q	UNDIFFERENTIATED			
	TERTIARY	Tfl	FLAXVILLE Fm.			
		To	ARIKAREE Fm.			
		Twr	WHITE RIVER GROUP			
		Tw	WASATCH Fm.			
		Tfu	FORT UNION Fm.			
MESOZOIC		Kh	HELL CREEK Fm.			
	CRETACEOUS	Kf	FOX HILLS Ss.			
		Kb	BEARPAW SHALE	Kp	PIERRE SHALE	
		Kj	JUDITH RIVER Fm. CLAGGETT SHALE EAGLE SANDSTONE			
		Ku	CRETACEOUS UNDIFFERENTIATED INCLUDES FORMATIONS OF THE COLORADO GROUP AND INYAN KARA GROUP	Kc	COLORADO Sh.	
	JURASSIC	Ju	MORRISON Fm. SUNDANCE Fm.			
PALEOZOIC	TRIASSIC PERMIAN	Tp	SPEARFISH Fm. OPECHE Fm.			
	PENN. MISC.	Pm	MINNELUSA Fm. MADISON GROUP			
	ORDOVICIAN	Ow	WHITEWOOD Fm.			
	CAMBRIAN	Cd	DEADWOOD Fm.			
PRECAMBRIAN		pC	UNDIFFERENTIATED			
IGNEOUS ROCKS						
TERTIARY		Ti	QUARTZ MONZONITE AND RHYOLITE			
PRECAMBRIAN		pCi	GNEISSOID GRANITE AND PEGMATITES			

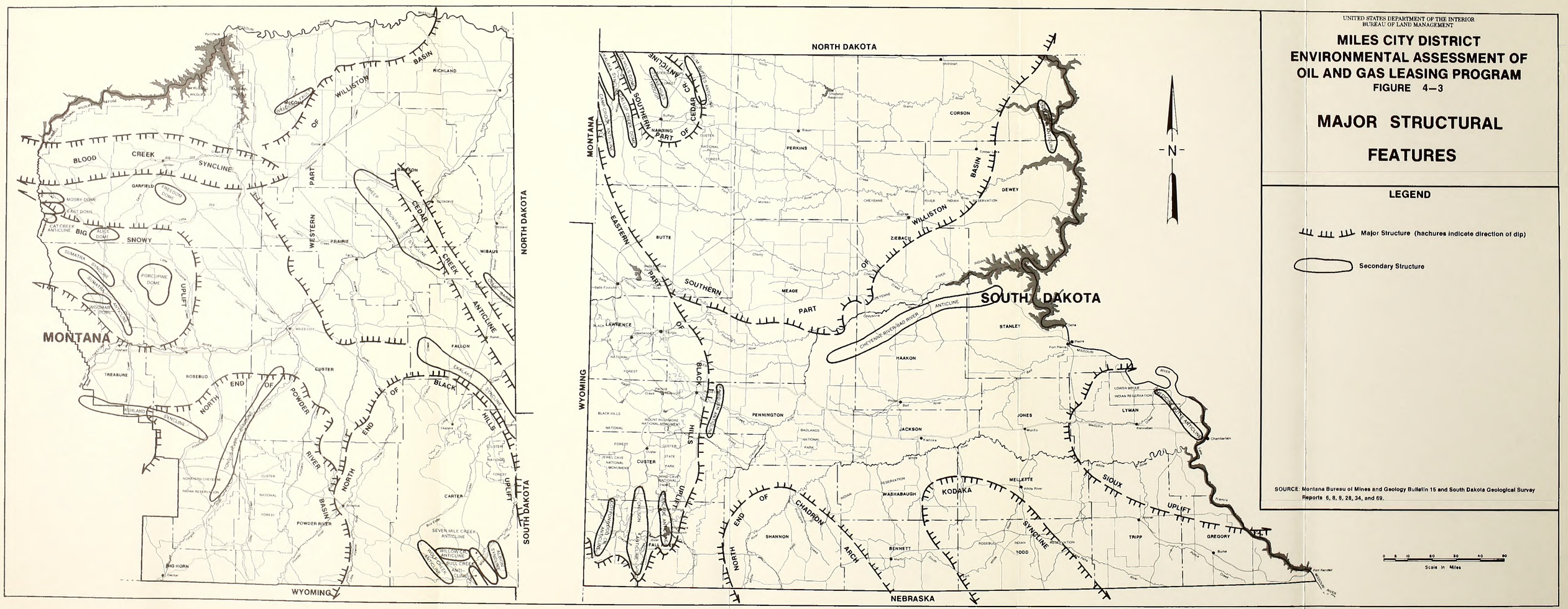
SOURCE: Montana Bureau of Mines and Geology, 1958 and U.S. Geological Survey, 1951

FIGURE 4-2



SOURCE: R.A.SCHOON 1974,
C.A.BALSTER 1971,
A.F. AGNEW & P.C.TYCHSON 1965.

CORRELATION CHART
MILES CITY DISTRICT



UNITED STATES DEPARTMENT OF THE INTERIOR
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MILES CITY DISTRICT ENVIRONMENTAL ASSESSMENT OF OIL AND GAS LEASING PROGRAM

FIGURE 4–3

MAJOR STRUCTURAL FEATURES

LEGEND

Major Structure (hachures indicate direction of dip)

Secondary Structure

SOURCE: Montana Bureau of Mines and Geology Bulletin 15 and South Dakota Geological Survey Reports 6, 8, 9, 28, 34, and 69.

Early Paleozoic (i.e., 600 million years ago) and continued through most of the Cenozoic Era. Attitudes of the strata display a gentle dip toward the center of the basin. Figure 4-4 shows the comparative size and relationship of the Williston Basin to other structural features in the Northern Great Plains region.

Powder River Basin

This elongated basin is bordered on the west by the Big Horn Mountains uplift and on the east by the Black Hills uplift. The basin extends from Miles City, Montana, into east-central Wyoming. The strata within the study area have a slight slope to the south which is locally modified by minor anticlinal noses and folds.

Black Hills Uplift

The uplift is a broad north-trending anticline structure about 200 miles long situated between the Powder River Basin to the west and the Williston Basin to the northesat. Sedimentary rocks on the flanks of the uplift are deformed by northward-trending anticlines, synclines, and monoclines, and by nearly circular domes and depressions. Local steeply dipping normal faults are common. The hills rise three to four thousand feet above the surrounding plain. The major part of the uplift probably occurred at the close of the Laramide Orogeny (Early Tertiary).

Cedar Creek Anticline

This northwest-trending fold extends for about 150 miles from Montana through North Dakota and into South Dakota. The anticline is asymmetrical throughout most of its length except in South Dakota where it becomes symmetrical. Strata dip steeply off the southwest flank and more gently to the northeast. The anticline has a slight plunge to the north. A number of normal faults have been mapped on the eastern flank. The structure interrupts the gentle dip of the Williston Basin and is thought to be the result of sedimentary strata draping over a large fault in the Precambrian basement rocks.

Sheep Mountain and Ekalaka Synclines

These two structures appear to be related to the Cedar Creek Anticline. The folds are nearly parallel to the axis of the anticline and they also plunge to the northwest.

Big Snowey Uplift

This broad rectangular uplift extends from the Big Snowey and Judith Mountains eastward to the Porcupine Dome area. The north and south margins of the uplift are marked by belts of steeply inclined strata and a series of asymmetrical anticlines, synclines, and folds or domes. The uplift probably represents a series of horsts and grabens that originate in the underlying basement rocks. Most of the Tectonic movement apparently took place approximately 70 million years ago during the Early Tertiary.

Blood Creek Syncline

The syncline is a broad, rather shallow, eastward plunging depression that lies north of and adjacent to the Big Snowey Uplift.

Weldon Fault Zone

The Weldon fault and the orientation of drainage patterns in this portion of Montana may be surface expressions of earlier Paleozoic structures. The displacement of beds in the Weldon fault is approximately 100 feet.

Cottonwood Creek, Chilson, and Cascade Anticlines

This series of folds mark the southern extension of the Black Hills Uplift. Chilson, the largest of the anticlines, can be traced across the South Dakota border into Nebraska. All three anticlines plunge to the south.

Chadron Arch and Sioux Uplift

Both of these structures were positive or uplifted features at the beginning of the Cretaceous Period. Precambrian rocks in the Sioux Uplift were the most important source of Lower Cretaceous sediments in South Dakota.

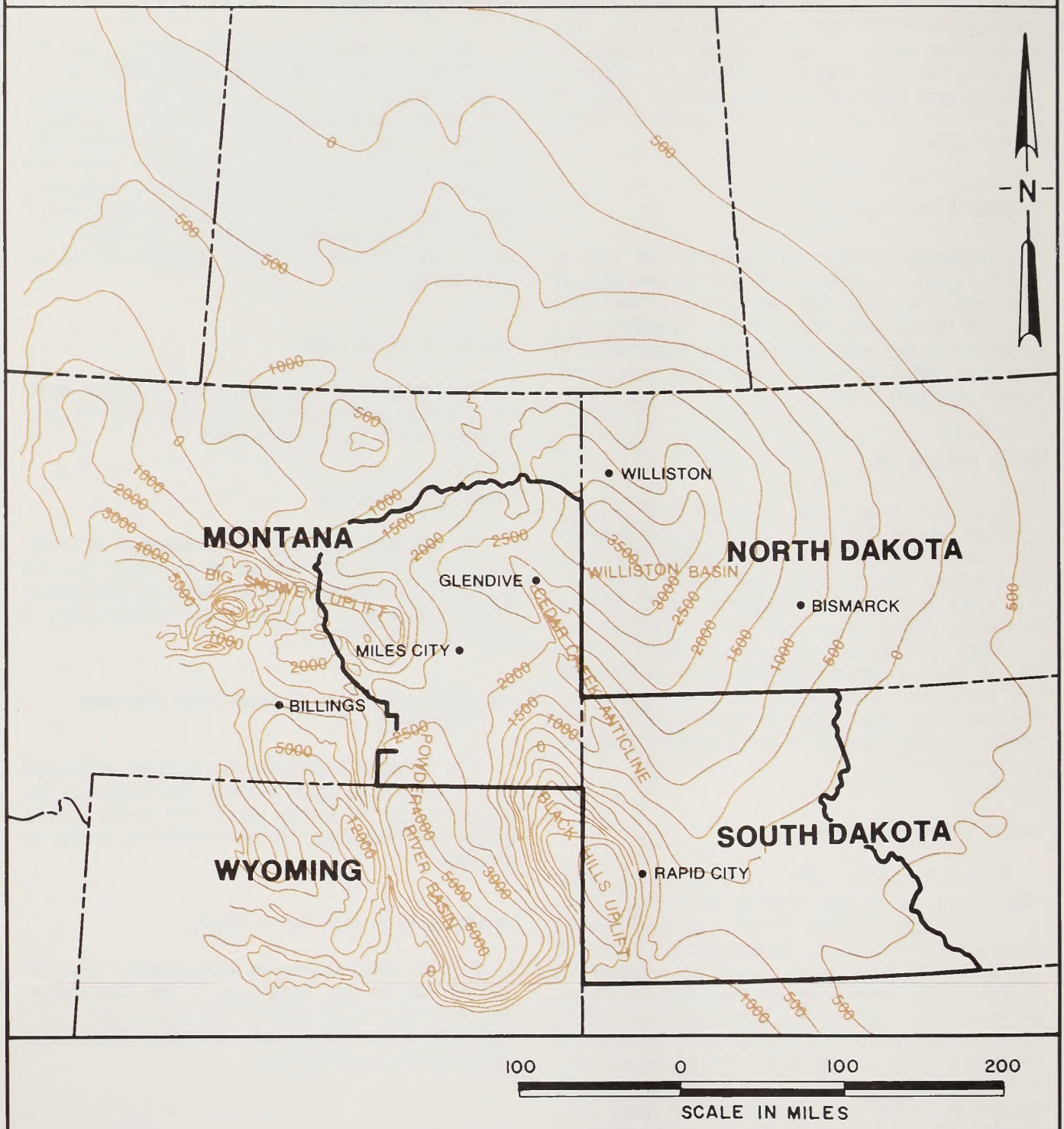
Minerals

Oil and Gas

Oil and gas have been found in the region's structural basins. Oil will travel or migrate over long distances and updip through porous strata such as sandstone and porous limestone. Eventually, the oil becomes trapped and migration ceases. Stratigra-

FIGURE 4—4

STRUCTURAL FEATURES OF THE NORTHERN GREAT PLAINS REGION



LEGEND

Structure contour on the base of the Colorado Shale. Datum is sea level.

SOURCE: Montana Bureau of Mines and Geology, Bulletin 15.

phic traps can form when formations thin and pinch out, or during a change in rock porosity or lithology. Structural features (anticlines, synclines, domes, faults, etc.) form traps where oil and gas sometimes accumulate.

The District has high potential for additional development of oil and gas resources and currently administers approximately 11.7 million acres of federal mineral estate (Figure 4-5). Western areas of the Williston Basin, particularly in the vicinity of Sidney, Montana, are currently experiencing considerable oil and gas activity. This area is becoming one of the nation's major on-shore prospecting areas. Exploration targets are aimed at both stratigraphic and structural traps that occur in Jurassic to Ordovician formations.

The Bell Creek Reservoir in southeastern Montana is a productive stratigraphic trap. Lower Cretaceous Muddy Sandstone forms a highly porous barrier island-type deposit. The updip impermeable barrier is believed to be formed by fine-grained sand and siltstone which were deposited in a lagoon environment. This type of producing formation in the Powder River Basin of Wyoming and southeastern Montana may be closely related to the ancient Black Hills Syncline. A thickening of strata indicates that the Black Hills area was a regional syncline during the Early Cretaceous. If oil and gas began to migrate soon after deposition and compaction of the source beds, migration would have been both eastward and westward from the synclinal axis. The full potential of the Powder River Basin has not been developed; the potential for oil and gas accumulation east of the Black Hills may be comparable.

Montana's first oil boom began in the Cat Creek anticlinal trend on the northern portion of the Big Snowey Uplift. Producing formations range from Missippian to Cretaceous Age and targets are stratigraphic traps that have structural control.

Figure 4-6 shows Known Geological Structures (KGS). These are areas determined by the U.S. Geological Survey known to contain significant oil and gas reserves. Substantial portions of western South Dakota and southeastern Montana are stratigraphically and structurally similar to present producing areas, although they are comparatively unexplored. It is expected that oil and gas production throughout the district will increase as the increased price of domestic oil and gas stimulates activity and more efficient development and production procedures are utilized. Figure 4-6 also shows the total cumulative county by county oil production as of December 31, 1977, and the potential production given current knowledge and technology. Comparable data are not available for gas production. Table 4-1 and Figure 4-7 describe the major oil and gas fields in the study area by county and type.

Coal

A substantial portion of the nation's western coal reserves is located in the Williston and Powder River Basins of Montana, Wyoming, and the Dakotas; this coal occurs mainly in the Fort Union Formation. Estimated reserves in excess of 45 billion tons of strippable subbituminous coal and lignite are reported to underlie the study area. This estimate will probably be revised upward as future exploration is completed. Figure 4-8 shows the current Known Recoverable Coal Resource Areas (KRCRAs) as determined by the U.S. Geological Survey. Also shown are the boundaries of the Powder River region (underlain by subbituminous coal) and the Fort Union Region (underlain by lignite).

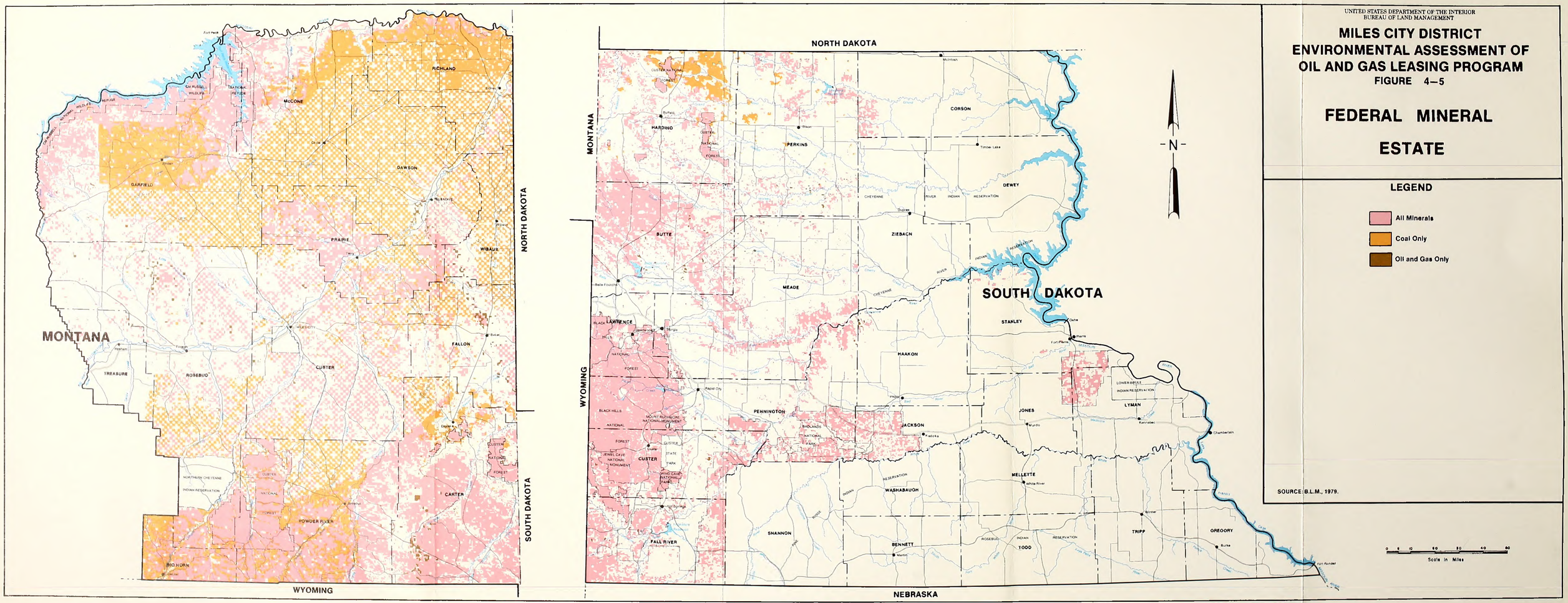
Coal is expected to provide the nation's energy base during the transition from oil and gas to some alternative energy source(s). Most of this resource that underlies the western states is at or near the surface and low in sulfur, which makes it a relatively economical fuel source. Consequently, an increasing amount of coal development and utilization is expected in the future.

Metallic Minerals

Enrichment and/or replacement ore bodies of the northern Black Hills region are associated with structural irregularities caused by the intrusion of Tertiary igneous rocks. Mineralized solutions accompanying or following the intrusions were selectively deposited along folds and fractures in the Precambrian Homestake Formation. The Homestake Mining Company's operation in Lead, South Dakota, is currently the largest producer of gold in the United States. Other metals such as silver, lead, and zinc also occur in the mineralized zones.

Uranium

In northwestern South Dakota and adjacent areas of Montana and North Dakota, uranium-bearing lignite beds occur in the Cretaceous Hell Creek Formation and the Paleocene Fort Union Formation. Most of the known beds of uraniferous lignites are closely overlain by rocks of the White River Group and the Arikaree Formation which contain about 12 times more uranium that the average sedimentary rock. Field relationships suggest that the accumulation of uranium in the lignite is secondary in origin and was derived from the overlying sediments.



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MILES CITY DISTRICT ENVIRONMENTAL ASSESSMENT OF OIL AND GAS LEASING PROGRAM

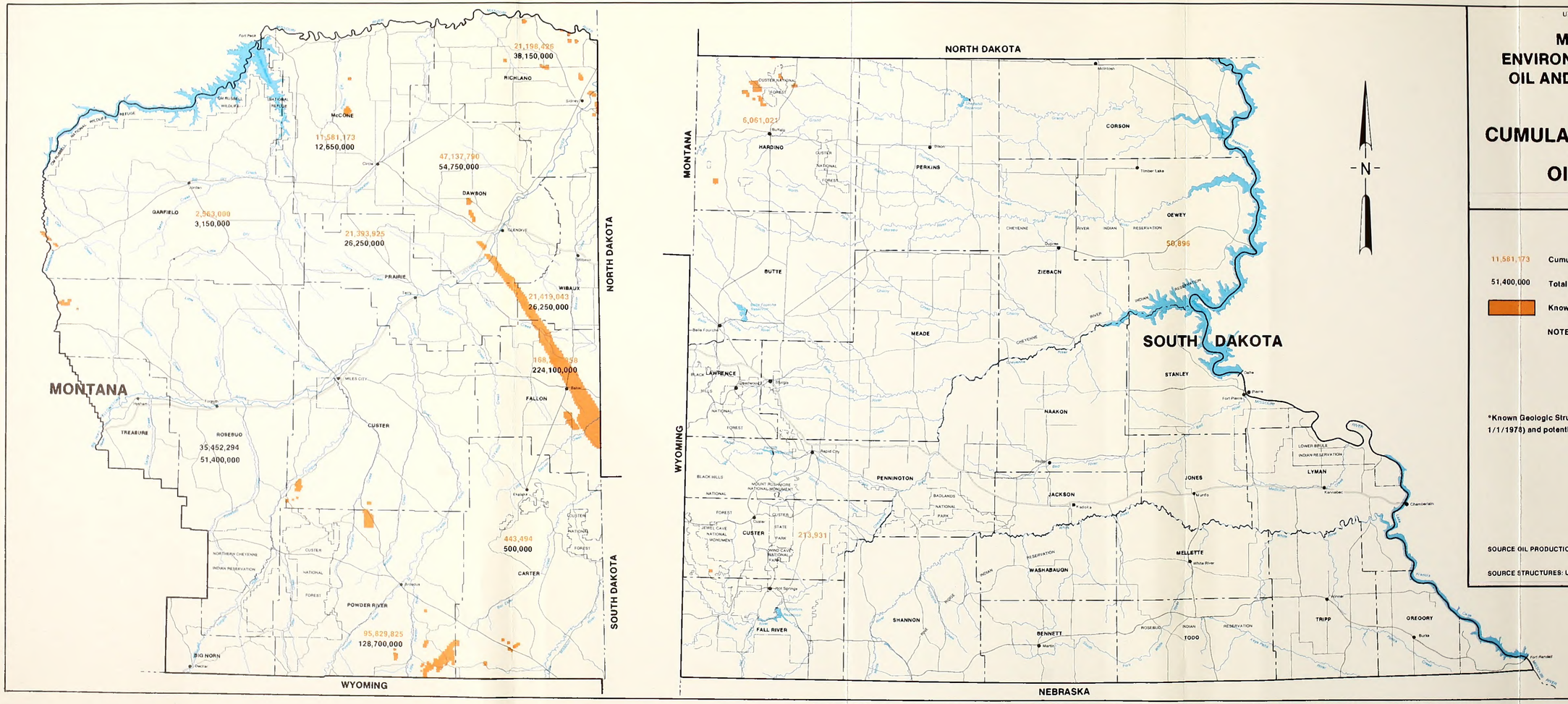
FIGURE 4–5

FEDERAL MINERAL ESTATE

LEGEND

- All Minerals
- Coal Only
- Oil and Gas Only

SOURCE: B.L.M., 1979.



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MILES CITY DISTRICT ENVIRONMENTAL ASSESSMENT OF OIL AND GAS LEASING PROGRAM

FIGURE 4—6

CUMULATIVE AND POTENTIAL OIL PRODUCTION*

LEGEND

11,581,173	Cumulative Oil Production as of December 31, 1977 by county (Bbls)
51,400,000	Total Potential Oil Production by county (Bbls)
	Known Geologic Structures

NOTE: No potential production data for South Dakota.

*Known Geologic Structure's integrated with data on cumulative production (as of 1/1/1978) and potential oil production (primary and secondary methods) by county.

SOURCE OIL PRODUCTION: Montana Oil and Gas Conservation Commission, 1977, and U.S. Geological Survey, 1977.

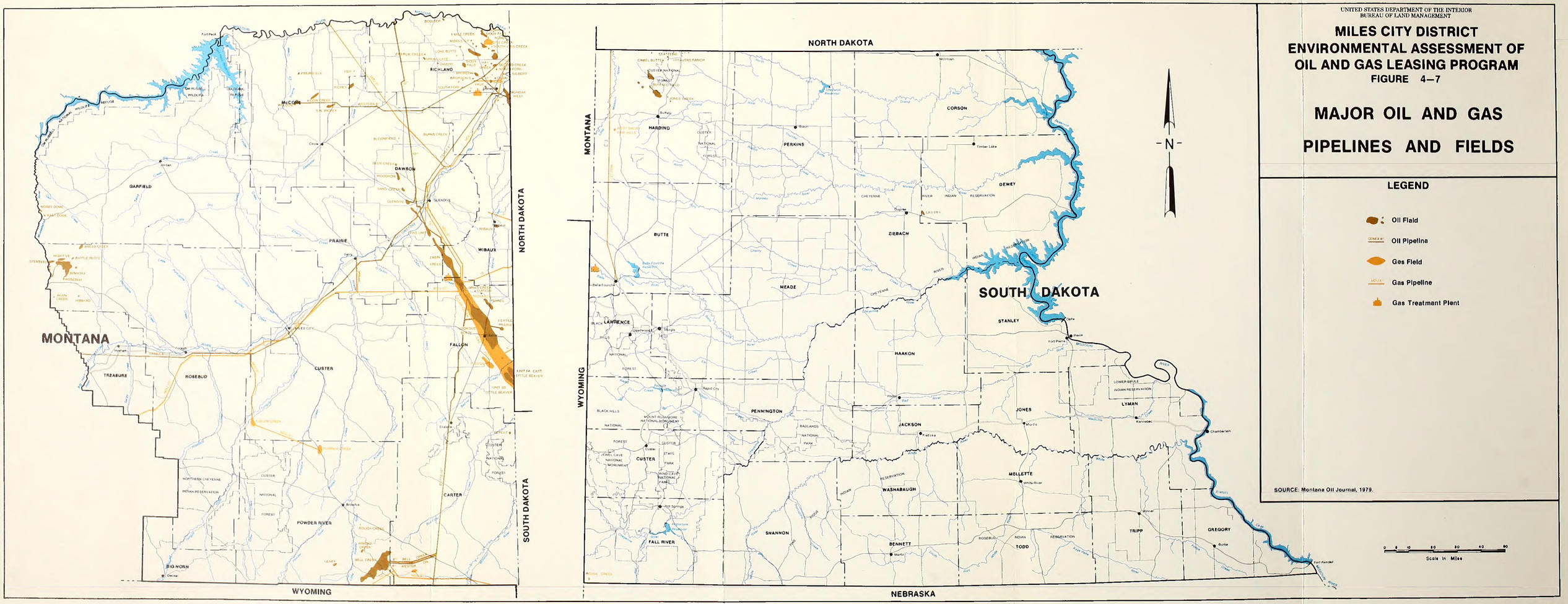
SOURCE STRUCTURES: U.S. Geological Survey, 1979.

TABLE 4-1

MAJOR STUDY AREA OIL AND GAS FIELDS

Field	Production	Formation and Age	Type of Trap	County
		Montana		
Bell Creek	Oil	Muddy - Cretaceous	Stratigraphic	Powder River
Cabin Creek	Oil	Interlake - Silurian Red River - Ordovician	Structural Structural	Fallon
Cedar Creek	Gas	Judith River - Cretaceous Eagle - Cretaceous	Structural Structural	Fallon
Gas City	Oil	Red River - Ordovician	Structural	Dawson
Girard	Oil	Red River - Ordovician	Structural-Stratigraphic	Richland
Glendive	Oil	Red River - Ordovician	Structural-Stratigraphic	Dawson
Liscom Creek	Gas	Shannon - Cretaceous	Structural-Stratigraphic	Custer
Little Beaver	Oil	Red River - Ordovician	Structural	Fallon
Pine	Oil	Interlake - Silurian Red River - Ordovician Mission Canyon - Mississippi	Structural Structural Structural	Dawson, Fallon Prairie, Wibaux
Plevna	Gas	Judith River - Cretaceous	Structural	Fallon
Pumpkin Creek	Gas	Shannon - Cretaceous	Structural	Custer
Richey, SW	Oil	Interlake - Silurian	Structural	McCone
Rough Creek	Oil	Muddy - Cretaceous	Structural-Stratigraphic	Powder River
Second Creek	Oil	Red River - Ordovician	Structural	Richland
Sumatra	Oil	Tyler - Pennsylvanian	Structural	Rosebud
Weldon	Oil	Kibby - Mississippian	Structural	Custer
		South Dakota		
Buffalo	Oil	Red River - Ordovician	Structural-Stratigraphic	Harding
W. Short Pine Hills	Gas	Cretaceous	Structural	Harding
Barker Dome	Oil	Minnelusa - Pennsylvanian	Structural	Custer
Indian Creek	Oil/Gas	Minnelusa	Structural	Fall River

SOURCES: Montana Oil & Gas Conservation Division, Annual Report for the Year 1971, Vol. 21 1978; Personal Communications, South Dakota Geological Survey, Rapid City 1979.



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MILES CITY DISTRICT ENVIRONMENTAL ASSESSMENT OF OIL AND GAS LEASING PROGRAM

FIGURE 4–7

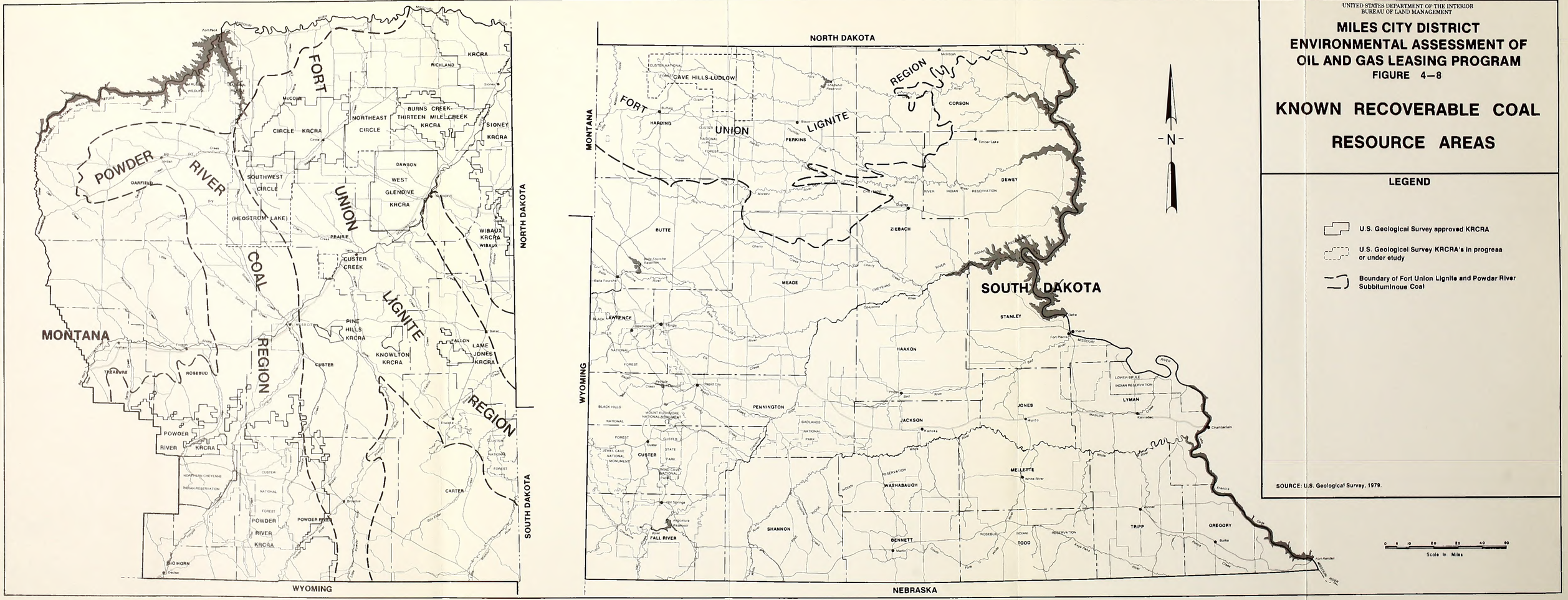
MAJOR OIL AND GAS PIPELINES AND FIELDS

LEGEND

- Oil Field
- Oil Pipeline
- Gas Field
- Gas Pipeline
- Gas Treatment Plant

SOURCE: Montana Oil Journal, 1979.

Scale in Miles



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MILES CITY DISTRICT ENVIRONMENTAL ASSESSMENT OF OIL AND GAS LEASING PROGRAM

FIGURE 4—8

KNOWN RECOVERABLE COAL RESOURCE AREAS

LEGEND

- U.S. Geological Survey approved KRCRA
- U.S. Geological Survey KRCRA's in progress or under study
- Boundary of Fort Union Lignite and Powder River Subbituminous Coal

SOURCE: U.S. Geological Survey, 1979.

Uranium concentration has occurred in sandstone lenses and roll front deposits in the southern Black Hills. Several mines have produced ore from the Cretaceous Inyan Kara Group since uranium was discovered in this area in 1951.

Industrial Material

Construction grade sand and gravel can be found on terraces and in the floodplains of selected drainages within the district. However, the deposits are usually too small and sporadic to be utilized as road material. Often, an inferior substitute locally referred to as scoria is used instead.

Gypsum crops out in beds 10 to 30 feet thick in the Triassic Spearfish Formation and Pennsylvanian Minnelusa Formation that encircle the Black Hills. Gypsum from this area is currently being utilized in the manufacture of cement in Rapid City, South Dakota.

Bentonite beds in the Cretaceous Mowry Shale near Alzada, Montana, have been mined since the late 1940s. Clay beds in the Pierre Shale and Hell Creek Formations in South Dakota contain a lower quality (lower sodium content) bentonite.

Paleontology

The Tullock Member of the Tertiary Fort Union Formation and the Cretaceous Hell Creek Formation are the most important vertebrate fossil-bearing formations in the district. The Tullock Member contains fossils of early transitional mammals, along with crocodiles and other reptiles. The Hell Creek Formation contains dinosaur fossils such as Tyrannosaurus and Triceratops.

SOILS

The Miles City District contains about 300 soil series, individually formed by the interaction of soil parent material, climate, topography, plants, and animals. Wide variations in soil parent material, climate, and topography account for the many different series and associations.

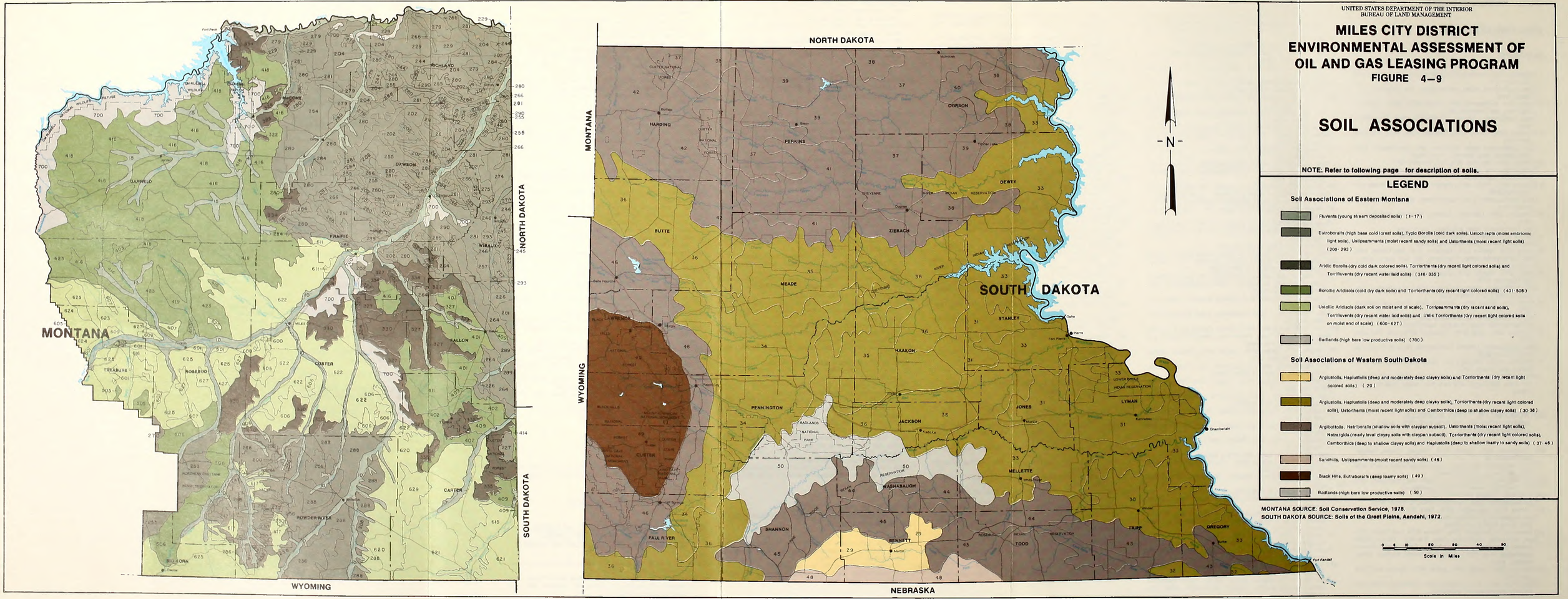
Soil Classification

Soil series with similar characteristics are commonly grouped into series associations in order to impart a more general knowledge of a given area. Characteristics of the various soil series identified in eastern Montana and South Dakota were obtained from published soil survey reports, generalized soil maps, and other material from the U.S. Soil Conservation Service (SCS) and other government agency sources.

Maps showing soil associations give a general overview of the soils in an area and can be used to locate tracts that are generally suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, wildlife area; planning the management of a farm or field; or selecting the proper location for a road, building, or similar structure. However, the soils in any one association ordinarily differ in slope, depth, drainage, amount of rock fragments, and other characteristics that affect their use and management.

Detailed soil surveys are currently being conducted in both eastern Montana and South Dakota by the Soil Conservation Service, U.S. Department of Interior, Bureau of Land Management, Bureau of Indian Affairs, state universities, and experiment stations. As these surveys become available, this information will be available for updating and supplementing existing surveys.

The soils association map shown in Figure 4-9 covers the general soils in the district. Table 4-2 provides a description of soil association groupings by acreage. The survey level shown in Figure 4-9 allows analysis of major soil associations found in a given area. However, the soils in one association may occur in another association, but in a different pattern or areal extent.


MONTANA
NORTH DAKOTA
SOUTH DAKOTA
WYOMING
NEBRASKA
N
Fort Peck
Malta
Glasgow
Wolf Point
Scobey
Culbertson
Poplar
Froid
Sidney
Glendive
Circle
Jordan
Miles City
Baker
Ekalaka
Broadus
Hardin
Billings
Forsyth
Colstrip
Lame Deer
Crow Agency
Lodge Grass
Hysham
Roundup
Harlowton
Lewistown
Winnett
Jordan
Big Timber
Livingston
Bozeman
Three Forks
Dillon
Butte
Anaconda
Deer Lodge
Missoula
Hamilton
Stevensville
Lolo
Kalispell
Whitefish
Columbia Falls
Libby
Eureka
Troy
Bonners Ferry
Sandpoint
Coeur d'Alene
Kellogg
Wallace
Mullan
Superior
Thompson Falls
Plains
Paradise
Hot Springs
Ronan
Polson
Dayton
Big Arm
Somers
Bigfork
Whitefish
Columbia Falls
Kalispell
Libby
Eureka
Troy
Bonners Ferry
Sandpoint
Coeur d'Alene
Kellogg
Wallace
Mullan
Superior
Thompson Falls
Plains
Paradise
Hot Springs
Ronan
Polson
Dayton
Big Arm
Somers
Bigfork
Valier
Conrad
Shelby
Cut Bank
Browning
Choteau
Fairfield
Great Falls
Belt
Stanford
Lewistown
Winnett
Jordan
Big Timber
Livingston
Bozeman
Three Forks
Dillon
Butte
Anaconda
Deer Lodge
Missoula
Hamilton
Stevensville
Lolo
Kalispell
Whitefish
Columbia Falls

SOIL ASSOCIATIONS

EASTERN MONTANA

FLUVENTS

1 Trembles 35%, Havrelon 25%, Lohler 25%, Banks, Benz and Bowdoin 15%
Typic Ustifluvents; deep, coarse-loamy, fine-loamy and fine, nearly level
3 Lohler 35%, Hoffmanville 20%, Marias 20%, Banks, Bowdoin, Havrelon, and Trembles 25%
Typic Ustifluvents - Ustertic Torrifluvents; deep, fine, nearly level
4 Havrelon 30%, Cherry 40%, Trembles 20%, Benz and Bowdoin 10%
Typic Ustifluvents; deep, fine-loamy and coarse-loamy Typic Ustochrepts; deep, fine-silty, nearly level
6 Glenberg 35%, Havrelon 30%, and Manning 35%
Typic Ustifluvents Typic Haploborolls; deep, coarse-loamy and fine-loamy, nearly level
9 Glendive 30%, Havre 20%, Harlem 20%, Marias, Vanda and Trembles 30%
Ustic Torrifluvents; deep, coarse-loamy, fine-loamy and fine, nearly level
10 Haverson 60%, Lohmiller, Bankard, Glenberg, and Hysham 40%
Ustic Torrifluvents; deep, fine-loamy, nearly level
11 Harlem 80%, Bowdoin, Nobe, and Havre 20%
Ustic Torrifluvents; deep, fine, nearly level
13 Havre 50%, Harlem 30%, Glendive 10%, and Others 10%
Ustic Torrifluvents; deep, fine-loamy, fine and coarse-loamy, nearly level
14 Havre 40%, Harlem 30%, Bowdoin 20%, Nobe, McKenzie, and Glendive 10%
Ustic Torrifluvents; deep, fine-loamy and fine - Ustertic Torrifluvents; deep, fine, nearly level
15 Havre 30%, Macay 40%, Glendive 20%, Benz and Bowdoin 10%
Ustic Torrifluvents; deep, fine-loamy and coarse-loamy - Borollic Camborthids; deep, fine-silty, nearly level
16 Lohmiller 25%, Kyle 25%, Haverson 20%, and Wet land 30%
Ustic Torrifluvents - Ustertic Camborthids; deep, fine and fine-loamy, nearly level
17 Haverson 40%, McRae 25%, Heldt 20%, Glenberg, Fort Collins, and Arvada 15%
Ustic Torrifluvents - Ustollic Camborthids - Ustertic Camborthids; deep, fine-loamy, and very fine, nearly level to gently sloping

EUTROBORALFS, TYPIC BOROLLS, USTOCHREPTS, USTORTHENTS, AND USTIPSAMMENTS

200 Campspass 50%, Barvon 45%, Ringling, Cabba, Reland, and Farland 5%
Typic Eutroboralfs; deep, fine - Entic Haploborolls; moderately deep, fine-loamy, sloping to steep
202 Farnuf 75%, Shambo 10%, Turner and Beaverton 15%
Typic Argiborolls; deep, fine-loamy, nearly level
204 Vida 60%, Williams 25%, and Zahill 15%
Typic Argiborolls; deep, fine-loamy, rolling to nearly level
211 Turner 65%, Beaverton 25%, Tally 5% and Farnuf 5%
Typic Argiborolls, moderately deep, fine-loamy and loamy-skeletal, nearly level to undulating
223 Morton 45%, Arnegard 15%, Chama 20%, and Others 20%
Typic Argiborolls; moderately deep, fine-silty - Pachic Haploborolls; deep, fine-loamy, undulating - Typic Ustipsamments; moderately deep, hilly - Typic Ustorthents; shallow, loamy-skeletal, steep
226 Morton 35%, Chama 20%, Vebar 20%, Flasher and Arnegard 15%
Typic Argiborolls - Typic Haploborolls; moderately deep, fine-silty and coarse-loamy, undulating
227 Reeder 30%, Vebar 20%, Flasher 20%, Cabba 20%, and Others 10%
Typic Argiborolls - Typic Haploborolls; moderately deep, fine-loamy and coarse-loamy, undulating - Typic Ustipsamments; moderately deep, hilly - Typic Ustorthents; shallow, loamy-skeletal, steep
229 Vida 45%, Zahill 40%, Williams and Shambo 15%
Typic Argiborolls - Typic Ustorthents; deep, fine-loamy, undulating to gently rolling
230 Farland 70%, Cabba 20%, Campspass, Barvon, Kyle and Ringling 10%
Typic Argiborolls; deep, fine-silty, gently sloping - Typic Ustorthents; shallow, loamy, steep
234 Farnuf 35%, Savage 30%, Lohler 20%, Havrelon, Banks, and Lambert 15%
Typic Argiborolls - Typic Ustifluvents; deep, fine-loamy and fine, nearly level
244 Shambo 40%, Vida 40%, Zahill, Lambert, and Cherry 20%
Typic Haploborolls - Typic Argiborolls; deep, fine-loamy, nearly level to rolling
245 Ringling 30%, Morton 20%, Lambert 20%, Chama 15%, and Searing 15%
Typic Haploborolls; shallow, fragmental, hilly - Typic Argiborolls; moderately deep - Typic Ustorthents; deep, fine-silty, undulating to hilly
246 Chama 50%, Morton 20%, Lambert 20% and Others 10%
Typic Haploborolls - Typic Argiborolls; moderately deep - Typic Ustorthents; deep, fine-silty, undulating to steep
247 Ringling 50%, Fergus 25%, Retan 15%, Farland, Midway, and Cabba 10%
Typic Haploborolls; shallow, fragmental, hilly - Typic Argiborolls - Typic Haploborolls; deep, fine and coarse-loamy, nearly level
248 Shambo 85%, Tally and Cherry 15%
Typic Haploborolls; deep, fine-loamy, nearly level to sloping
253 Ringling 35%, Searing 20%, Arnegard 15%, Farnul, Savage, Reeder, Doney, and Gail 35%
Typic Haploborolls; shallow, fragmental, hilly and moderately deep, fine-loamy, undulating - Pachic Haploborolls; deep, fine-loamy, gently sloping
254 Chama 40%, Lambert 40%, Cherry, Shambo, Farland, and Farnut 20%
Typic Haploborolls - Typic Ustorthents; deep, fine-silty, undulating to steep
255 Shambo 65%, Lambert 25%, Cherry, Farnuf, and Vida 10%
Typic Haploborolls Typic Ustorthents; deep, fine-loamy and fine-silty; sloping and steep
256 Ringling 40%, Cabba 25%, Yawdim 20%, Farland, Rapelji, Campspass, Barvon 15%
Typic Haploborolls; shallow, fragmental, hilly - Typic Ustorthents; shallow, loamy and clayey, rolling
257 Moreau 45%, Dimyaw 25%, Regent 20%, Rhoades and Shale outcrop 10%
Typic Haploborolls - Typic Ustorthents - Typic Argiborolls; deep, fine, nearly level to rolling
260 Korchea 40%, Farnut 20%, Savage 20%, Shaak, Lennep, and Xavier 20%
Fluventic Haploborolls - Typic Argiborolls; deep fine-loamy and fine, nearly level
264 Rhoades complex 35%, Flasher and Lambert 35%, and Shambo 30%
Leptic Natriborolls; deep, fine, nearly level to sloping - Typic Ustipsamments; shallow, steep - Typic Haploborolls; deep, fine-loamy, nearly level
266 Cherry 70%, Savage, Shambo, Trembles, and Havrelon 30%
Typic Ustochrepts; deep, fine-silty, gently sloping
269 Doney 30%, Reeder 20%, Wayden 20%, Farnuf, Shaak, Savage, and Dast 30%
Typic Ustorthents; moderately deep, fine-loamy and shallow, clayey, rolling - Typic Argiborolls; moderately deep, fine-loamy, undulating
270 Wayden 40%, Regent 25%, Shale outcrop, Lennep, Savage, Cherry, and Doney 35%
Typic Ustorthents; shallow, clayey, rolling - Typic Argiborolls; moderately deep, fine, undulating
271 Wayden 30%, Xavier 20%, Belfield 10%, Eltsac, Norbert, Shaak, Reeder, and Lennep 40%
Typic Ustorthents; shallow, loamy, rolling - Typic Argiborolls; deep, fine-silty, sloping - Glossic Natriborolls; deep, fine, nearly level
274 Lambert 65%, Chama 25%, Farnuf, Cherry and Shambo 10%
Typic Ustorthents; deep, fine-silty - Typic Haploborolls; shallow, fragmental and moderately deep, silty, hilly steep and undulating
275 Lambert 35%, Ringling 20%, Chama 20%, and Others 25%
Typic Ustorthents; deep, fine-silty - Typic Haploborolls; shallow, fragmental, and moderately deep, silty, hilly, steep and undulating
276 Abac 25%, Paretsa 25%, Rottulee, Wayden, Twin Creek, and Fergus 40%
Typic Ustorthents; shallow, loamy - Typic Haploborolls; moderately deep, fine-silty, rolling and sloping
277 Dast 40%, Vebar 15%, Parshall 10%, Farnul, Shaak, Wayden, and Doney 35%
Typic Ustorthents - Typic Haploborolls; moderately deep, coarse-loamy, rolling - Pachic Haploborolls; deep, coarse-loamy, gently sloping
279 Zahill 40%, Lambert 40%, Vida, Williams, and Shambo 20%
Typic Ustorthents; deep, fine-loamy and fine-silty, rolling to steep
280 Lambert 60%, Dast, Blanchard, Dimyaw, Chama, and Shambo 40%
Typic Ustorthents; deep, fine-silty, steep
281 Lambert 50%, Dimyaw 40%, Shale outcrop, Chama, Shambo, and Dast 10%
Typic Ustorthents; deep, fine-silty and fine, rolling to steep
284 Tinsley 55%, Lambert 30%, Dast and Shambo 15%
Typic Ustorthents; shallow, sandy-skeletal and deep, fine-silty, rolling to steep
286 Lambert 35%, Brandenberg, 25%, Searing and Others 40%
Typic Ustorthents; deep, fine-silty - Lithic Ustorthents; shallow, loamy-skeletal, rolling to steep
288 Cabba-Shingle 40%, Wayden-Midway 40%, Farnut-Thurlow 20%, Cushman, Hesper, Campspass, and Barvon 20%
Typic Ustorthents - Ustic Torriorthents; shallow, loamy and clayey, hilly - Typic Argiborolls - Ustollic Haplargids; deep, fine-loamy and fine, nearly level
289 Norbert 70%, Vanda 20%, Shale outcrop and Marias 10%
Typic Ustorthents; shallow - Ustic Torriorthents; deep, clayey, hilly and nearly level
290 Dast 40%, Blanchard 40%, Lambert, Shambo, and Tally 20%
Typic Ustorthents; moderately deep coarse-loamy, undulating to hilly - Typic Ustipsamments; deep, rolling
293 Flasher 55%, Vebar 30%, Arnegard, Parshall and Rock outcrop 15%
Typic Ustipsamments; moderately deep, hilly - Typic Haploborolls; modetately deep, coarse-loamy, undulating

ARIDIC BOROLLS, TORRIORTHENTS, AND TORRIFLUVENTS

316 Boxwell 35%, Attewan 30%, Dast 25%, Assinniboine, Scroggins, and Cabbart 15%
Aridic Haploborolls and Argiborolls; moderately deep, fine-loamy, nearly level to sloping - Ustic Torriorthents; deep, coarse-loamy, hilly and steep
322 Sunburst 50%, Scobey 40%, and PhillipsElloam complex 10%
Ustic Torriorthents; deep, fine, steep - Aridic Argiborolls; deep, fine, undulating
323 Lambert 50%, Brussett 30%, Yamac, Ethridge, Floweree, Yawdim and Tussler 20%
Ustic Torriorthents - Aridic Argiborolls; deep, fine-silty, steep and undulating
324 Dast 30%, Scroggin 20%, Boxwall 20%, and Others 30%
Ustic Torriorthents; deep and moderately deep, fine-loamy and fine-silty, hilly and steep - Aridic Haploborolls; moderately deep, line-loamy, sloping
327 Scroggin 35%, Yawdim 20%, Shale outcrop 15%, Lonepine, Cabbart, Boxwell, and Lambeth 30%
Ustic Torriorthents; moderately deep and shallow, fine-silty and clayey, hilly and steep
330 Lambeth 35%, Brandenberg 25%, and Others
Ustic Torriorthents; deep, fine-silty, rolling - Lithic Ustorthents, loamy-skeletal, hilly
334 Lambeth 50%, Tusler 40%, Yamac and Yawdim 10%
Ustic Torriorthents; deep, fine-silty - Ustic Torripsamments; moderately deep, rolling to hilly
335 Rentsac 35%, Tusler 25%, Boxwell 25%, Cabbart and Rock outcrop 15%
Lithic Ustic Torriorthents; loamy-skeletal, steep - Ustic Torripsamments - Aridic Haploborolls; moderately deep, fine-loamy, sloping

BOROLLIC ARIDISOLS, TORRIORTHENTS, ARIDIC USTOLLIS, AND USTIC TORRIORTHENTS

401 Series not identified
Borollic Haplargids and Camborthids; moderately deep and deep, fine and line-silty; undulating - Ustic Torriorthents; deep, fine-silty, and moderately deep, line and fine-loamy, hilly
402 Series not identified
Borollic Haplargids, moderately deep, fine, undulating - Ustic Torriorthents; shallow, clayey and deep, fine-silty, hilly
403 Series not identified
Borollic Haplargids; moderately deep and shallow - Lithic Ustic Torriorthents; loamy-skeletal, nearly level and steep
409 Series not identified
Borollic Camborthids and Haplargids; moderately deep, coarse-loamy and fine-loamy, undulating - Ustic Torriorthents; deep, fine-silty and shallow, loamy and clayey, steep
411 Series not identified
Borollic Camborthids; moderately deep, fine-silty, undulating - Ustic Torriorthents; moderately deep, fine-loamy, shallow, clayey and deep, fine-silty, hilly
416 Lambeth 45%, Yamac 40%, Floweree and Evanston 15%
Ustic Torriorthents; deep, fine-silty, steep - Borollic Camborthids; deep, fine-loamy, sloping
418 Yawdim 60%, Lambeth, Shale outcrop, and Yamac 40%
Ustic Torriorthents; shallow, clayey, rolling to steep
419 Vanda 75%, Lisam 20%, and Others 5%
Ustic Torriorthents; deep and shallow, fine, undulating to steep
423 Thebo 40%, Lisam 30%, Absher 15%, Yawdim and Shale outcrop 15%
Ustertic Torriorthents; moderately deep, very fine, rolling - Ustic Torriorthents; shallow, clayey, steep - Borollic Natrargids; deep, fine, nearly level
500 Beauvais 40%, Colby 30%, Onray, Gilt Edge, Shonkin, and Richfield 30%
Aridic Argiustolls; deep, fine-silty, gently sloping
503 Nunn 35%, Fort Collins 30%, McRae 20%, Havre and Lohmiller 15%
Aridic Argiustolls; deep, fine - Ustollic Haplargids - Ustollic Camborthids; deep, line-loamy, nearly level
504 Midway 45%, Nunn 30%, Thedalund, Heldt, and Pierre 25%
Ustic Torriorthents; shallow, clayey, rolling - Aridic Argiustolls; deep, fine, nearly level
505 Nelson 55%, Alice 25%, Travessilla, Thedalund, Tullock, and Rock outcrop 20%
Ustic Torriorthents; moderately deep - Aridic Haplustolls; deep, coarse-loamy, hilly and nearly level
506 Wibaux 30%, Thedalund 20%, Spearman 20%, Nelson, Chugter, Cushman, and McRae 30%
Ustic Torriorthents; shallow, fragmental and moderately deep, fine-loamy - Aridic Haplustolls; moderately deep, fine-loamy, hilly

USTOLLIC ARIDISOLS, USTIC TORRIORTHENTS, TORRIFLUVENTS AND TORRIPSAMMENTS

600 Wanetta 35%, Keiser 30%, and Hilly gravelly land 35%
Ustollic Haplargids; moderately deep and deep, fine-loamy and fine-silty, gently sloping
601 Wanetta 50%, Hesper 30%, and Olney 20%
Ustollic Haplargids; moderately deep and deep, fine-loamy and fine-silty, nearly level
604 Keiser 30%, Hydro 20%, Gilt Edge 15%, Shonkin, Colby, Harvey, and Clapper 35%
Ustollic Haplargids - Glossic Ustollic Natrargids - Ustollic Natrargids; deep, fine-silty and fine, nearly level
606 Cushman 30%, Midway 20%, Shingle 20%, Razor, Renohill, Arvada, and McRae 30%
Ustollic Haplargids; moderately deep, fine-loamy, undulating - Ustic Torriorthents; shallow, clayey and loamy, rolling
607 Terry 50%, Olney 30%, Tullock 10%, Thedalund and Travessilla 10%
Ustollic Haplargids; moderately deep and deep, fine-loamy - Ustic Torripsamments; moderately deep, sloping to hilly
609 Gilt Edge 60%, Arvada 25%, Lismas, Nihill, and Midway 15%
Ustollic Natrargids; deep, fine, nearly level
611 Heldt 30%, Lohmiller 30%, Fort Collins 30%, McRae and Arvada Complex 10%
Ustertic Camborthids - Ustic Torrifluvents - Ustollic Haplargids; deep, very fine, fine and fine-loamy, nearly level to gently sloping
616 Pierre 35%, Lismas 30%, Kyle 15%, Vananda, Allentine, Arvada, and Bone 20%
Ustertic Camborthids; moderately deep and deep, very fine, undulating and nearly level - Ustic Torriorthents; shallow, clayey, steep
617 Midway 45%, Thurlow 35%, Shingle, Kyle, Rapelji, and Galata 20%
Ustic Torriorthents; shallow, clayey, rolling - Ustollic Haplargids; deep, fine, nearly level
620 Shingle 40%, Remmit 20%, Oceanet 20%, Cushman, Absher, and Bone complex 20%
Ustic Torriorthents; shallow and moderately deep, coarse-loamy, undulating to hilly
621 Lismas 45%, Pierre 40%, Kyle, Vanada, and Shale outcrop 15%
Ustic Torriorthents; shallow, clayey, hilly - Ustertic Camborthids; moderately deep, very fine, undulating
622 Bainville 40%, Midway 20%, Shale outcrop 20%, Other soils 20%
Ustic Torriorthents; moderately deep, fine, silty and shallow, clayey, sloping to very steep
623 Vanada 75%, Lismas 20%, and Others 5%
Ustic Torriorthents; deep and shallow, fine, undulating to steep
624 Bainville 60%, Cushman, Tullock, Fattig, Travessilla, and Nunn 40%
Ustic Torriorthents; moderately deep, fine-silty, rolling
625 Thedalund 30%, Midway 30%, McRae, Fort Collins, Thurlow, Cushman, Shale, and Sandstone outcrop 40%
Ustic Torriorthents; moderately deep and shallow, fine-loamy and clayey, hilly
627 Midway 35%, Vanada 30%, Shale outcrop 15%, Nunn, Razor, Thedalund, Shingle, and McRae 20%
Ustic Torriorthents; shallow, clayey and deep, fine, rolling, undulating and steep
629 Lismas 40%, Shale Outcrop 40%, and Pierre 20%
Ustic Torriorthents; shallow, clayey, hilly

BADLANDS

700 Series not identified
Shale Outcrop - Ustic Torriorthents; shallow, moderately deep and deep - Ustic Torrifluvents and Camborthids; deep

WESTERN SOUTH DAKOTA

DEEP SOILS FORMED MAINLY IN LOESS, SILTY GLACIAL DRIFT, OR LOESS MANTLED GLACIAL TILL ON UPLANDS

29 Nearly level to rolling silty and loamy soils formed in loess and residuum from sandstone.
Argiustolls (Keith, Richfield, and Rosebud) are dominant. Less extensive are Haplustolls (Oglala and Ulysses) and Torriorthents (Canyon and Colby).

SOILS FORMED MAINLY IN RESIDUUM FROM CLAYEY OR SILTY SHALES ON UPLANDS

30 Deep and moderately deep, nearly level to rolling, clayey soils.
Argiustolls (Millboro and Boyd) and Ustochrepts (Lakome) are dominant. Minor soils include Okaton, Opal, Reliance, and Sansarc.
31 Deep and moderately deep, nearly level to rolling, clayey soils.
Haplustolls (Opal and Promise) are dominant. Minor soils include Kolls and Sansaic.
32 Mainly deep and moderately deep, undulating to steep clayey soils.
Clayey Haplustolls (Boyd) and Argiustolls (Reliance) are dominant. Less extensive soils include Anselmo, Lakoma, and Okaton.
33 Moderately deep and shallow, undulating to steep, clayey soils.
Ustorthents (Sansarc and Okaton) and Haplustolls (Opal and Promise) are dominant. Minor soils include Camborthids (Chantier and Swanboy).
34 Deep to shallow, undulating to hilly, clayey and loamy soils
Argiustolls (Santana and Nunn), shallow Torriorthents (Samsil and Lismas), and Camborthids (Pierre and Swanboy) are dominant. Minor soils include Menter, Kadoka, and Epping.
35 Moderately deep and deep, undulating to rolling clayey and loamy soils.
Clayey Camborthids (Pierre and Kyle) and loamy Argiborolls (Ralph) are dominant. Minor soils include Regent, Rhome, Twilight, and Absher.
36 Deep to shallow, undulating to hilly, clayey soils.
Camborthids (Pierre and Kyle) and Torriorthents (Lismas and Samsil) are dominant.

SOILS FORMED IN MIXED SANDY AND LOAMY MATERIALS, MODIFIED BY WIND AND WATER, AND RESIDUUM FROM SANDSTONE, SILTSTONE, AND SHALE ON UPLANDS

37 Moderately deep and shallow, nearly level to rolling, loamy and clayey soils.
Loamy Argiborolls (Morton and Reeder), Natriborolls (Rhoades and Belfield), and shallow Ustorthents (Cabba) are dominant.
38 Moderately deep and shallow, nearly level to rolling loamy soils.
Argiborolls (Morton and Reeder), Haploborolls (Amor), and shallow Ustorthents (Cabba and Wayden) are dominant. Minor soils include Moreau, Grail, and Linton.
39 Moderately deep and shallow, nearly level to rolling, loamy to sandy soils.
Haploborolls (Vebar and Amor), Argiborolls (Reeder and Morton), and shallow Ustipsamments are dominant. Minor soils include Tally, Telfer, and Parshall.
40 Moderately deep and shallow, undulating to steep loamy soils.
Ustorthents (Cabba, Wayden) and Argiborolls (Morton) are dominant. Minor soils include Reeder and Linton.
41 Nearly level clayey soils with claypan subsoils.
Absher soils are dominant. Minor soils include Marmarth and Twilight.
42 Camborthids-Natrargids; shallow, undulating to hilly soils and soils with claypan subsoils.
Torriorthents (Cabbart and Scroggin), Camborthids (Twilight), Natrargids (Absher), and Natriborolls (Ekalaka and Sorum) are dominant. Minor soils include Rhame and Zeona.
43 Deep to shallow, nearly level to hilly, loamy to sandy soils.
Haplustolls (Anselmo, Vetal, and Ronson), Argiustolls (Holt and Tuthill), and Ustorthents (Tassel) are dominant. Minor soils include Canyon, Elsmere, Dunday, and Valentine.
44 Deep to shallow, undulating to hilly silty soils.
Argiustolls (Kadoka and Keith) and Torriorthents (Keota and Epping) are dominant. Minor soils include Richfield, Huggins, Canyon, Wanblee and Wortman.
45 Deep to shallow, undulating to hilly, loamy to sandy soils.
Haplustolls (Oglala and Dailey) and Torriorthents (Tassel and Canyon) are dominant. Minor soils include Keith, Ulysses, and Colby.
46 Deep to shallow, rolling to steep, silty to clayey soils.
Clayey Torriorthents (Grummit and Midway) and silty and loamy Torriorthents (Nevee, Spearfish, Minnequa, Enning, Butche, Canyon, and Colby) are dominant.

SOILS FORMED IN ALLUVIUM ON BOTTOMLAND

47 Deep, nearly level clayey soils.
Haplaquolls (Luton) dominate. Other soils include sandy Sarpy soils, clayey Albaton soils, and loamy Haynie soils.

SOILS OF THE SANDHILLS

48 Deep, undulating to rolling sandy soils.
Ustipsamments (Valentine) is dominant. Minor soils include Dunday and Elsmere.

SOILS OF THE BLACK HILLS

49 Deep, rolling to steep, loamy soils.
Eutroboralfs (Buska and Citadel) are dominant. Minor soils include Euthrochrepts (Hisega and Vanocker), Lithic Haploborolls (Paunsaugunt), and Cryoboralfs (Stovho).

SOILS OF THE BADLANDS

50 Geologically eroded badlands from soft silty to clayey geologic formations.
Relief ranges from almost vertical walls to nearly level on mesas and in basins. Includes some grassed areas.

TABLE 4-2

SOILS OF THE STUDY AREA BY ACREAGE AND PERCENT

MONTANA	Public Surface[1/]	% of Total Public Surface	Total[1/]
Fluvents (1-17)	251,253	9	1,761,444
Eutroboralfs, Typic Borolls, Ustochrepts, Ustorthents, Ustipsamments (200-293)	999,178	35	6,654,344
Aridic Borolls, Torriorthents, and Torrifluvents (316-335)	167,502	6	1,174,295
Borollic Airidsols and Torriorthents (401-506)	642,091	23	4,501,468
Ustollic Aridisols, Ustic Torriorthents, Torrifluvents and Torripsamments (600-627)	614,174	22	4,305,752
Badlands (700)	139,585	5	978,580
	2,791,700	99	19,571,800
SOUTH DAKOTA			
Argiustolls, Haplustols, Ustorthents, Torriorthents, Camborthids (30-36)	157,941	63	16,382,309
Argiustolls, Haplustolls, Torriorthents (29)	5,094	2	582,461
Sandhills, Ustipsamments (48)	5,094	2	582,461
Argibollols, Natriborolls, Ustorthents, Natraraids, Torriorthents, Camborthids, Haulustols (37-46)	53,496	21	5,548,846
Black Hills, Eutroboralfs (49)	15,284	6	1,585,384
Badlands, Torriorthents (50)	15,284	6	1,585,384
	254,744	99	26,423,080

1/ Assumes random distribution of soils regardless of ownership. Acreages are estimates only.

SOURCE: Compiled by Bump and Volk 1979.

Summary of Soil Characteristics

Soils of the district, like most of the semi-arid west, present a wide variation in development, depth, color, fertility, and other properties (Table 4-3). These soils have developed from a variety of parent materials such as glacial till, sandstone silts, and clay shales. Soil textures are as varied as the parent material with silt loam, loam, and clay loam being the dominant surface textures. The organic material content is generally low and the retention of calcium carbonate and soluble salts is generally high. Most soils are highly corrosive to uncoated steel, and moderately to negligibly corrosive to for concrete. Soil depth varies from a few inches in steep areas to six feet or more in alluvial areas. Slope ranges from nearly level (0-2%) to very steep (45-90%), with most slopes less than 15%. Soil permeabilities range from very slow to very rapid and are well or excessively well drained on most sites.

Erosion susceptibility in the district is generally moderate to severe from wind and water, although upland soils as a rule are more susceptible to erosion. Slope is an important factor as steeper slopes are more easily eroded. Water erosion occurs under a variety of conditions and may be caused by rainfall, melting snow, irrigation water, or by stream or river flow. Water erosion is the most widespread type in the study area. Rill and gully erosion may be severe regardless of soil type. Vegetative cover plays an important role in controlling erosion.

Soil pH ranges from a pH of over 7 to a pH of 9 (i.e., slightly basic). Soils with a more neutral pH tend to support shrubs and pines, while more alkaline soils produce grasses, forbs, and low shrubs.

Shrink-swell properties of soils range from low to high. Generally, the soil in the district have moderate to high shrink-swell potential. Soils with high shrink-swell potential can exert great lateral and vertical forces with changes in moisture. Damage can result to surface or underground structures; offsetting design features are often used in these types of soils.

Agricultural productivity varies by area and soil series. Table 4-4 describes soil properties in relation to potential productivity. Generally, soils in eastern Montana are not well suited to intensively cultivated agriculture. The limited areas of farmland are located on stream and river terraces and on deep soils in the uplands. Irrigated soils in the alluvial valleys and low terraces have the greatest potential for being considered as prime farmlands if they meet the chemical criteria.

Bentonites are an important non-renewable resource and are quite common in portions of southeastern Montana and South Dakota. Bentonites are clays formed from volcanic ash and contain large amounts of montmorillonite minerals. Montmorillonite appears to be the dominant clay minerals with illite and kaolinte found in varying amounts.

Bentonite has singularly interesting characteristics. Bentonite has high shrink-swell potential and a high water holding capacity due to its physical and chemical bonding. Its swelling, water thickening, and gelling action is useful for oil and gas drilling fluids. Bentonite is sometimes used in moderate levels as a sealant for permeable soil horizons in slag ponds and slurry trenches. Sometimes bentonite is used to control pollution by preventing contaminates from moving into surrounding soils or water tables.

Soil surveys of sufficient detail to determine land use potential within the study area are now becoming available. The development of impact prediction on any given portion of the area depends upon the availability of a detailed soil survey or on-the-ground inventory work. As more soils information is obtained for each county or area, it will be used to update the existing data. Appendix 4-1 shows the current status of soil surveys which are in progress.

TABLE 4-3

Properties of Selected Soil Series in the Study Area

SOIL SERIES	THICKNESS OF SOLUM A&B HORIZONS	DOMINANT SURFACE TEXTURES	SUBSOIL TEXTURES	UNDERLYING MATERIAL (SUBSTRATA)	TOPOGRAPHY POSITION	SPECIAL MANAGEMENT	RANGE SOIL GROUP	GREAT GROUP	PERCENT SLOPE	ROADS DEVELOPMENTS BUILDINGS	RECLAMATION	SOURCE MATERIAL	DRAINAGE	pH	SHRINK-SWELL POTENTIAL	CORROSIVENESS STEEL	CORROSIVENESS CONCRETE
MONTANA:																	
Absarokee	18-30	loam & clay loams	clay	hardshale & sandstone	level bedrock benches	wind erosion	cy-sil	Argiboroll	0-2	severe	poor	unsuited	well drained	6.1-7.3	moderate	high	low
Badlands	very limited	clay-clay loams	clay-clay loams	hardshale & sandstone	rough broken hills	severe water & wind erosion	clays-silty clays		15-90	severe	very poor	unsuited	well drained	7.9-9.0	high	high	low
Bainville	limited	silt loam	silty loams	soft sandstone & sandstone	convex slopes on ridge crests & valley sides	wind & water erosion	silt	Torriorthent	4-45	moderate	good with slope	unsuited	well drained	6.6-8.4	low	high	low
Bearpaw	15-26	clay loam	clays or clay loams	clay loam & glacial till	nearly level terraces & fans		SWG	Argiboroll	0-2	severe	fair	poor	well drained	6.6-8.4	moderate-high	high	low
Bridger	17-48	loam & silt loam	clay or clay loams	silty loam & clay	sloping fan & footslopes in mountain valleys	water erosion	silt	Cryoboroll	2-4	moderate	poor	poor-fair	well drained	6.6-8.4	low-moderate	high	low
Chama	3-10	silt loam	silty loams	calcareous soil from weakly consolidated siltstone	convex slopes on ridge crests & valley sides	water erosion	silt	Haploboroll	4-45	moderate	poor	fair	well drained	7.4-8.4	low	high	low
Cherry	12-34	silty clay loam	silty clay loam	silty clay loam	sloping alluvial fans & terraces	water erosion	silt-clay	Camborthid	1-15	poor	fair-good	poor	well drained	6.6-9.0	moderate	high	moderate
Cushman	9-10	loams & clay loams	clay loams	shale & sandstone	nearly level to rolling uplands	water erosion	silt-clay	Haplargid	0-15	poor	fair	unsuited	well drained	6.6-7.3	low-moderate	high	low
Duncom	9-12	silty loam	silty loams-silty clay loam	limestone	steep mountain ridges	water erosion	SWL	Cryoboroll	2-30	poor	poor	poor	well drained	6.6-8.4	low-moderate	high	low
Flasher	limited	fine silty loams & loamy fine sands	fine sand	fine silt or soft sandstone	steep slopes on sides of plateau & valleys	wind & water erosion	sand	Haploboroll	25-45	moderate-severe	poor	good	excessively	7.4-7.8	low	moderate	low
Fort Collins	12-19	loams & clay loams	clay loams	stratified loam & fine silt	level to sloping terraces	wind & water erosion	silt-clay	Haplargid	0-15	moderate	good	unsuited	well drained	6.6-8.4	low-moderate	high	low
Havre	limited	loams & silty loams	loams & silty loams	stratified alluvium	nearly level flood-plain	flooding	Si-Ou-Sb	Torrifluvent	0-2	severe	fair-good	unsuited	well drained	7.4-8.4	low	high	low
Lismas	7-18	clay	clay	shale	rolling hills, uplands	wind & water erosion	SWC	Torriorthent	8-25	severe	poor	poor	well drained	7.4-9.0	high	high	moderate
Marginnis	6-24	clay & loams	clay loams or silty clay loams	fractured sandstone & shale	steep valley sides	water erosion	SWN	Haploboroll	25-45	severe	poor	unsuited	excessive	7.2-7.4	moderate	high	low
Midway	limited	clay loams	clay loams	soft shale & sandstone	convex slopes on ridge crests & valley sides	wind & water erosion	clay	Torriorthent	2-25	severe	poor-moderate	unsuited	well drained	7.9-9.0	high	high	low
Pierre	12-18	clay	clay loams	shale	undulating to hilly uplands	water erosion	clay	Camborthid	2-25	severe	poor	unsuited	well drained	6.1-8.4	high	high	low
Promise	12-19	clay	clay loams	clay & shale	nearly level to hilly	water erosion	clay	Pelloxerert	0-25	severe	poor	unsuited	well drained	6.1-9.0	low-high	high	low
Sprole	9-18	loams & clay loams	clay loams	loam glacial till	level to rolling till plain	water erosion	silt-clay	Argiboroll	0-15	severe	fair	poor	well drained	6.6-8.4	moderate	high	low
Tullock	8-15	fine sandy loams	fine sandy loams	loamy fine sand	steep uplands	wind erosion	silt	Torripsamment	25-45	moderate-severe	poor	fair	well drained	7.4-7.8	low	high	low
Wanetta	14-20	loams & clay loams	clay loams	sand & gravel	level fans & terraces	water erosion	silt-clay	Haplargid	0-2	moderate	fair-good	unsuited	well drained	6.6-8.4	low-moderate	high	low

TABLE 4-3

Properties of Selected Soil Series in the Study Area

SOIL SERIES	THICKNESS OF SOLUM A&B HORIZONS	DOMINANT SURFACE TEXTURES	SUBSOIL TEXTURES	UNDERLYING MATERIAL (SUBSTRATA)	TOPOGRAPHIC POSITION	SPECIAL MANAGEMENT	RANGE SOIL GROUP	GREAT GROUP	PERCENT SLOPE	ROADS DEVELOPMENTS BUILDINGS	RECLAMATION	SOURCE MATERIAL	DRAINAGE	pH	SHRINK-SWELL POTENTIAL	CORROSIVENESS STEEL	CORROSIVENESS CONCRETE
SOUTH DAKOTA:																	
Absher	5-24	silty clay	silty clay	silty clay	terraces & fans & uplands	water & wind erosion	thin clay-pan	Natrargids	0-6	severe	poor	poor-un-suited	moderate	7.4-8.4	high	high	moderate
Anselmo	5-26	fine sandy loam	sandy loam	tertiary sediments	uplands	bedrock, wind & water erosion, moisture conservation	sandy	Haplustolls	2-9	slight	fair	good-poor	well drained	6.6-7.3	low	low	low
Badlands					rough broken hills		badlands		0-90								
Belfield	24-31	silty clay	silty clay loam	silty clay loam & clay	uplands & terraces	slight erosion problems	clayey	Natriborolls	1-9	moderate-severe	fair-good	poor-fair	well drained	6.1-9	moderate	high	low
Boyd	5-26	clayey	clay	shale	steeplands	wind & water erosion	clayey	Agriustolls	6-19	severe	poor	poor	well drained				
Butche	limited	very fine sandy loam	siltstone	sandstone	uplands	subsurface rock	shallow	Torriorthents	15	severe	poor	poor	well drained	6.6-7.3	low	low	low
Cabba	2-7	loamy mix	loamy mix	sedimentary beds & rock	uplands	subsurface rock	shallow	Typic Ustorthents	4-70	moderate-severe	poor-fair	poor-fair	well drained	7.9-8.4	low	low	low
Cabbart	limited	loamy	loamy	siltstone	sedimentary plains	depth to rock	shallow	Torriorthents	8-45	severe	poor-fair	poor-un-suited	well drained	7.4-9.0	low-moderate	high	low
Canyon	limited	silt & silty	sandstone	limestone	rimrock in uplands	water erosion stand establishment	shallow	Torriorthents	2-15	moderate	poor	poor	well drained	7.4-8.4	low	low	low
Citadel	8-29	silty & loamy	silty & loamy	limestone, sandstone or shale	uplands in Black Hills	depth to rock	forest	Eutroboralfs	8-45	severe			well drained				
Colby	limited	silt & silty	silty clay loam	silt loam	subsurface lime, moderate erosion	frost action	silty	Torriorthents	2-8	poor	fair	poor	well drained	6.6-7.8	moderate	high	low
Ekalaka	21-28	fine sandy loam	loamy fine sand	sandstone	terraces	erosion problems piping	sandy	Natriborolls	0-9	fair	fair	poor-fair	well drained	6.1-9.0	low	high	moderate
Epping	limited	thin silty	silt loam	sandstone	uplands	wind & water erosion, stand establishment	shallow	Torriorthents	4-15	severe	poor	poor	well drained	7.9-8.4	low	high	low
Grummit	17-40	clayey	clayey	acid shale	uplands	shrink-swell depth to rock, high salts	shallow	Torriorthents	4-45	poor	poor	unsuited	well drained	3.5-4.5	high	high	high
Holt	6-22	fine sandy loam	sandy loam	sandstone	uplands	wind erosion	sandy	Argiustolls	0-9	slight	fair	poor-good	well drained	6.6-7.4	low	low	low
Kadoka	4-18	silt loam	silty clay loam	siltstone	uplands	wind & water erosion, stand establishment	silty	Argiustolls	0-15	moderate	poor	fair	well drained	6.6-8.4	low	moderate	low
Keith	5-26	silty & loamy	loamy & silty	alluvium & loess	tablelands	moisture conservation, nutrient maintenance	silty	Argiustolls	2-4	moderate	fair	poor	well drained	6.6-7.8	low	moderate	low
Kyle	18-40	clay	clay	shale	uplands	frost action, low strength	clayey	Camborthids	0-9	poor	fair-poor	fair	well drained	7.4-8.4	high	high	moderate
Lakoa	2-40	silty clays	clayey	shale	uplands	severe slopes 25%	clayey	Ustochrepts	6- 25	severe	poor	poor	well drained	5.6-6.5	low	low	moderate
Lismas	7-18	clay	clay	shale	rolling hills, uplands	wind & water erosion	shallow dense clay	Torriorthents	2-25	severe	poor-fair	poor	well drained	7.4-9.0	high	high	moderate
Midway	limited	clay loams	clay loams	soft shale & sandstone	convex slopes on ridge crests & valley sides	wind & water erosion	shallow	Torriorthents	2-25	severe	fair	poor	well drained	7.9-9.0	high	high	low
Millboro	5-32	silty clays	clay	silty clay or shale	steep lands	wind & water erosion	clayey	Argiustolls	25-90	severe	fair-good	poor	well drained	7.4-8.4	high	high	moderate
Minneqva	0-50	silty clays	silty clays	shale	uplands	wind & water erosion	thin upland	Torriorthents	6-9	severe	poor	poor	well drained	7.4-8.4	moderate	high	low

TABLE 4-3

Properties of Selected Soil eries in the Study Area

SOIL SERIES	THICKNESS OF SOLUM A&B HORIZONS	DOMINANT SURFACE TEXTURES	SUBSOIL TEXTURES	UNDERLYING MATERIAL (SUBSTRATA)	TOPOGRAPHY POSITION	SPECIAL MANAGEMENT	RANGE SOIL GROUP	GREAT GROUP	PERCENT SLOPE	ROADS DEVELOPMENTS BUILDINGS	RECLAMATION	SOURCE MATERIAL	DRAINAGE	pH	SHRINK-SWELL POTENTIAL	CORROSIVENESS STEEL	CONCRETE
SOUTH OAKOTA: (continued)																	
Nevee	0-60	silt loam	siltstone	siltstone or shale	uplands	depth to rock	thin upland	Torriorthents	0-15	moderate	good	fair	well drained	6.6-7.8	low	high	moderate
Nunn	24-29	clay loam	clay loam	clay loam	terraces & alluvial fans	seepage	clayey	Argiustolls	0-6	severe	fair-good	poor	well drained	6.6-8.4	low-moderate	moderate	low
Oglala	3-18	loam	silt loam	silt loam & sandstone	mantled glacial till on uplands or loess	wind & water erosion	silty	Haplustolls	9-18		fair		well drained	6.6-8.5	moderate		
Opal		clays		residiuum over shale	terraces, uplands	stand establishment	clayey	Haplustolls		moderate	poor-fair	poor-fair	well drained				
Pierre		clay	clay loam	shale	undulating to hilly uplands	water erosion	clayey	Camborthid	2-25	severe	fair	poor	well drained	6.1-8.4	high	high	moderate
Promise	12-19	clay	clay loam	clay & shale	nearly level to hilly	flooding, water erosion	clayey	Haplustolls	0-2	severe	fair	poor	well drained	6.1-9	high	high	low
Ralph	limited	loam	clay loam	shale or sandstone	erosion potential	depth to rock	silty	Argiborolls	3-6	moderate	good	fair	well drained	6.6-7.8	low-moderate	moderate	low
Reeder	limited	loam	clay loam	shale & sandstone		steep slopes, frost action, depth to rock	silty	Argiborolls		severe	fair	poor	well drained	7.4-7.8	moderate	high	low
Reliance		silty clay loams	silty	loess	terraces & uplands	moisture conservation, wind & water erosion	silty	Argiustolls	2-4		fair		well drained				
Rhoades							thin clay-pan	Natriborolls									
Richfield	3-30	silty & loamy	silty clay loam	loams	mantled glacial till on uplands or loess	piping, frost action	silty	Argiustolls	0-21	severe	fair	poor	well drained	7.4-7.8	moderate	high	low
Rosebud	2-22	silty & loamy	clay loam	sandstone	mantled glacial till on uplands or loess	erosion	silty	Argiustolls		fair	good	fair	well drained	6.6-8.4	moderate	moderate	low
Samsil	4-8	clayey	clayey	shale	uplands	wind & water erosion	shallow	Torriorthents	8-45	severe	poor-fair	poor	well drained	7.4-8.4	high	high	moderate
Satana	8-60	loam & clay loam	sandy clay loam	loam	uplands & high terraces	erosion potential	silty	Argiustolls	0-15	moderate	good	fair	well drained	6.1-7.8	moderate	moderate	low
Scroggin	20-40	loam	loam	siltstone	uplands	depth to rock	thin upland	Torriorthents	6-25	moderate	fair	fair	well drained	6.6-8.4	low	low	low
Spearfish	limited	loam	bedded siltstone	bedrock	gently hilly to rolling uplands	shallow soils	shallow	Torriorthents	5-40	moderate	poor-fair	poor	well drained	6.6-8.4	low	high	moderate
Tassel	4-10	sandy loam	sandy loam	sandstone	uplands	depth to sandstone & severe slopes	shallow	Ustorthents	3-40	severe	poor	good-fair	well drained	7.9-8.4	low	low	low
Tuthill	5-29	fine sandy loam	sandy clay loam	loamy sand	uplands	wind erosion	sandy	Argiustolls	0-9	moderate	fair	fair	well drained	7.4-8.4	low	low	low
Twilight	20-40	fine sandy loam	fine sandy loam	sandstone	uplands	depth to rock	sandy	Camborthids	3-25	slight	fair	fair	well drained	6.6-8.4	low	moderate	low
Ulysses	3-13	silty & loamy	silt loam	silt loam	mantled glacial till on uplands or loess	frost heaving, erosion	silty	Haplustolls	5-9	poor	good	fair-poor	well drained	6.6-8.4	low	moderate	low
Valentine	limited	fine sand	fine sand	fine sandy loam	uplands, sandhills	very severe wind erosion	sandy	Ustipsamments	5-30	slight	poor	fair	excessively drained	6.6-7.3	low	low	low
Vebar	9-12	fine sandy loam	fine sandy loam	bedrock	uplands	easily eroded	sandy	Haploborolls	1-15	moderate	good	poor	well drained	6.1-7.8	low	moderate	low
Vetal	5-35	fine sandy loam	sandy loam	alluvium wash	uplands	wind erosion	sandy	Haplustolls	0-5	fair	fair	good	well drained	6.6-7.3	low	moderate	low
Wayden	limited	silty clay	silty clay	platy silty clay shale	uplands	depth to rock, slopes	shallow	Ustorthents	1-50	severe	poor	unsuited	well drained	7.4-8.4	high	high	moderate

SOURCE: Compiled by Bump and Volk, 1979

TABLE 4-4

SOIL PROPERTIES AS RELATED TO POTENTIAL PRODUCTIVITY

Soil Property	Productivity Rating[1/]		
	Good	Fair	Poor
Texture (USDA)	Loam, silt loam, fine sandy loam	Silty clay loam, sandy clay loam, clay loam, sandy loam	Clay, loamy sand, sand
Gravel and Cobbles (percent)	Gravel - less than 15	Gravel, 15-50; cobbels, less than 15	Gravel - more than 50; cobbles, more than 15
Salinity (conductivity) of saturation extract) (mmhos/cm)	Less than 2	2-4	More than 4
Reaction (ph)	6.1-7.8	5.1-6.0; 7.9-8.5	Less than 5.0; More than 8.5
Inherent fertility	Very high, high	Moderate	Low, very low
Thickness of topsoil (inches)	More than 40	20-40	Less than 20
Topography (percent slope)	Less than 2	2-15	More than 15
Drainage	Good	Somewhat excessive, moderately good	Excessive, somewhat poor, poor, very poor

1/ Soil productivity is the capacity of a soil for producing a specified plant or sequence of plants under a physically defined set of management practices. The ratings above assume equal management practices and should be used only for purposes of clarification of terms in this document.

$$\text{Productivity Rating Index} = \frac{\text{Expected Yield Per Acre}}{\text{Standard Yield Per Acre}}$$

SOURCE: United States Department of Agriculture, Soil Conservation Service 1971.

TOPOGRAPHY

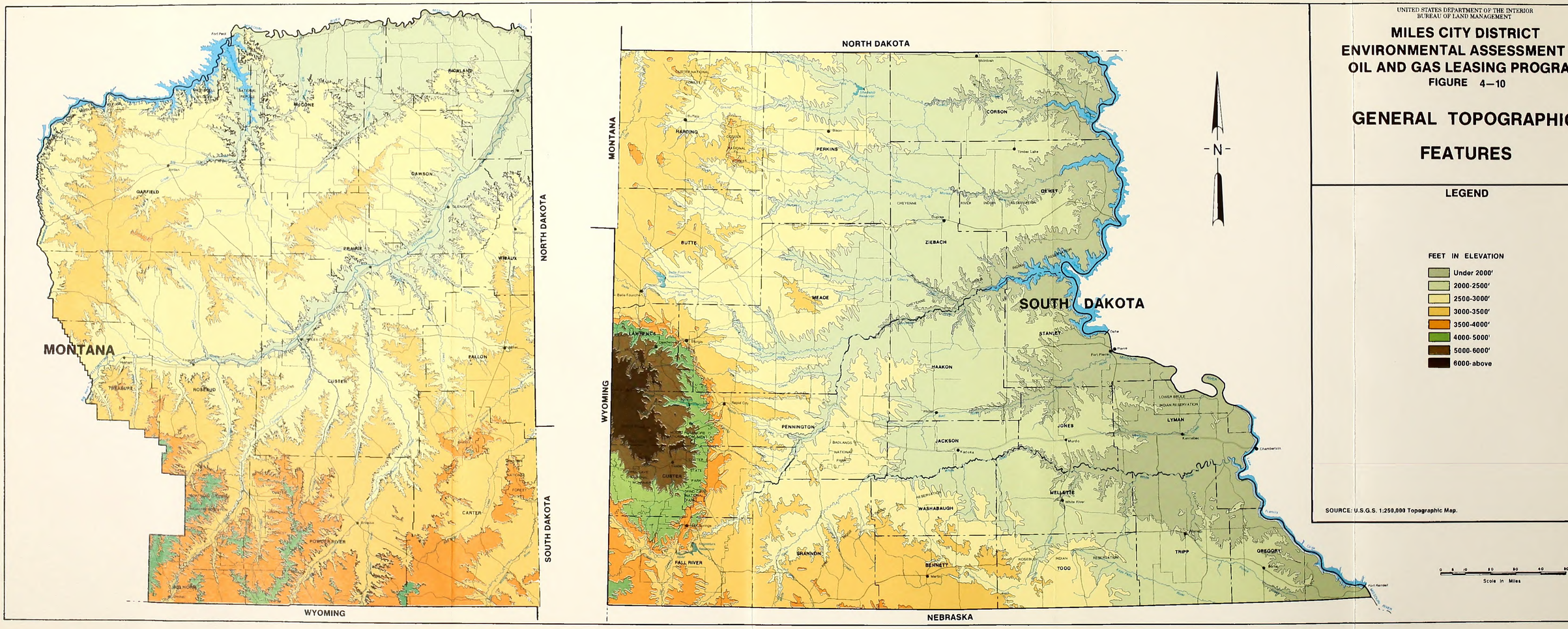
The gently rolling grass-covered plains, which overlie most of the area, are interrupted by higher, almost flat, plateaus. When these plateaus are dissected by differential erosion, spectacular badlands made up of mesas, cuestas, and capped buttes result. Badlands topography occurs along the east side of the Yellowstone River, along the south side of Fort Peck Reservoir in the "Breaks" area of the Missouri River, and along other major rivers. The associated steep sides have been gullied by intermittent runoff and seasonal streams. On the west side of the Yellowstone River there are at least five major steplike terraces. They average one mile to three miles wide and run for many miles along the river. These terraces indicate that the Yellowstone River has, in the past, shifted its course to the east. The major rivers have also formed broad valleys and floodplains. In the southern end of the state, there are several hills with elevations more than 4,400 feet above sea level. In most of the district, however, the elevation ranges from 1,900 feet at the river floodplains, to about 3,000 feet in the higher plateaus.

In South Dakota there are three major topographic features west of the Missouri River: the Black Hills area which has a rugged mountainous topography, the Badlands areas, and the Pierre Hills area. On the east side of the Missouri River are the Missouri Coteau (an excarpment forming the edge of a plateau or range of hills) and the Prairie Coteau with the James Basin separating them. These areas are characterized by glacial deposits such as ground moraines several hundred feet thick and dead-ice moraines. The elevation for most of South Dakota ranges from 1,500 to 3,500 feet above sea level. The one notable exception is the Black Hills area where several peaks range above 7,000 feet. Figure 4-10 presents general topographic information for the study area.

VEGETATION

Vegetation in the study area consists primarily of a grassland biome with pine savannahs and shrub types occurring at higher elevations. The regional biotic setting is a northern temperate prairie with a semi-arid climate. Considerable variation in soils and micro-climates exists throughout the study area, resulting in numerous plant communities. The large geographic scope of this study prevents individual descriptions of these plant communities. Therefore, broad vegetative and rangeland types are used in describing the existing environment of the vegetative resource.

Eleven vegetative types occur within the Montana portion of the study area. In some areas, two types are shown as undifferentiated. There are seven major vegetative types west of the Missouri River in South Dakota. The major characteristics of these rangeland types (Figure 4-11) are summarized in Table 4-5.



UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

MILES CITY DISTRICT ENVIRONMENTAL ASSESSMENT OF OIL AND GAS LEASING PROGRAM

FIGURE 4—10

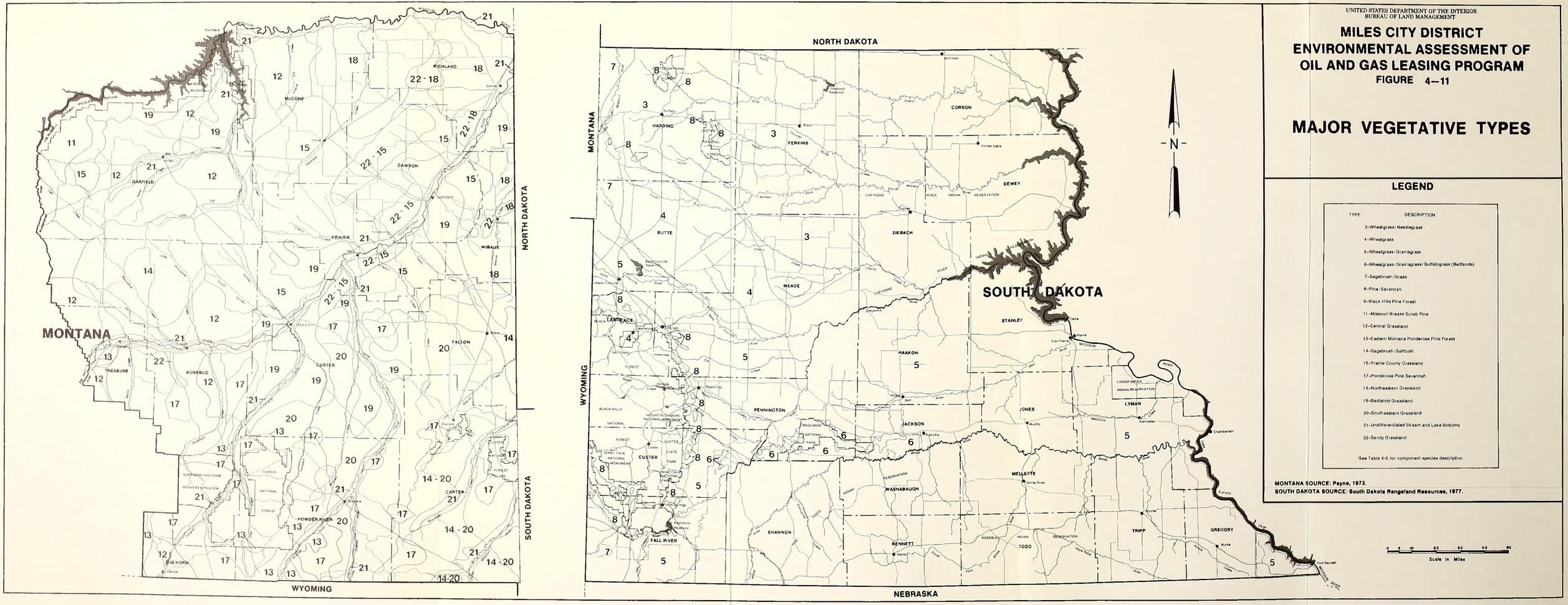
GENERAL TOPOGRAPHIC FEATURES

LEGEND

FEET IN ELEVATION

- Under 2000′
- 2000-2500′
- 2500-3000′
- 3000-3500′
- 3500-4000′
- 4000-5000′
- 5000-6000′
- 6000-above

SOURCE: U.S.G.S. 1:250,000 Topographic Map.



UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

MILES CITY DISTRICT ENVIRONMENTAL ASSESSMENT OF OIL AND GAS LEASING PROGRAM

FIGURE 4—11

MAJOR VEGETATIVE TYPES

LEGEND

TYPE[1]	DESCRIPTION
3	Wheatgrass/Needlegrass
4	Wheatgrass
5	Wheatgrass/Grama grass
6	Wheatgrass/Grama grass/Buffalograss (Badlands)
7	Sagebrush/Grass
8	Pine/Savannah
9	Black Hills Pine Forest
11	Missouri Breaks Scrub Pine
12	Central Grassland
13	Eastern Montana Ponderosa Pine Forest
14	Sagebrush/Saltbush
15	Prairie County Grassland
17	Ponderosa Pine Savannah
18	Northeastern Grassland
19	Badlands Grassland
20	Southeastern Grassland
21	Undifferentiated Stream and Lake Bottoms
22	Sandy Grassland

[1]See Table 4-5 for component species description.

MONTANA SOURCE: Payne, 1973.
SOUTH DAKOTA SOURCE: South Dakota Rangeland Resources, 1977.

TABLE 4-5

MAJOR VEGETATIVE TYPES WITHIN THE STUDY AREA

Montana

Type No.	Name	Principal Forage Species	Other Common Species	Overgrazing Indicators	Grazing Capacity	
					Present	Potential
11	Missouri Breaks Scrub-Pine	Bluebunch wheatgrass (Agropyron spicatum) Blue grama (Bouteloua gracilis) Plains muhly (Muhlenbergia cuspidata)	Ponderosa Pine (Pinus ponderosa) Juniper (Juniper spp.) Sagebrush (Artimisia spp.) Rabbitbrush (Chrysothamnus spp.) Yucca (Yucca spp.) Plains pricklypear (Opuntia polyacantha) Western wheatgrass (Agropyron smithii) Little bluestem (Schizochyrium scoparium) Sandberg bluegrass (Poa secunda) Threadleaf sedge (Carex filifolia) Phlox (Phlox spp.) Wild buckwheat (Eriogonum spp.)	Increase in broom snakeweed (Gutierrezia sarothrae) and plains pricklypear.	9.0 A/AUM	8.0 A/AUM
12	Central Grassland	Blue grama Western wheatgrass Needle-and-thread (Stipa comata)	Plains pricklypear Silver sagebrush (Artemisia cana) Fringed sagewort (Artemisia frigida) Broom snakeweed Sandberg bluegrass Green needlegrass (Stipa visdula) Bluebunch wheatgrass Plains reedgrass (Calamograstis montanensis) Prairie junegrass (Koeleria cristata) Plains muhly Threadleaf sedge	Increase in sagebrush, plains pricklypear, phlox, scarlet globemallow, fringed sagewort, and annual weeds. Decrease in needle-and-thread, grass, western wheatgrass, and increase in blue grama.	3.5 A/AUM	3.0 A/AUM

TABLE 4-5
(Cont.)

Type No.	Name	Principal Forage Species	Other Common Species	Overgrazing Indicators	Grazing Capacity	
					Present	Potential
12	Central Grassland (cont.)		Needleleaf sedge (Carex eleochasis) Phlox Wild buckwheat Scarlet globemallow (Sphaeralcea coccinea)			
13	Eastern Montana Ponderosa Pine Forest	Bluebunch wheatgrass Western wheatgrass Bluegrass (Poa spp.)	Rocky mountain juniper (Juniperus scopulorum) Skunkbrush sumac (Rhus trilobata) Western snowberry (Symphoricarpos occidentalis) Idaho fescue (Festuca idahoensis) Blue grama Sandberg bluegrass Prairie junegrass Needle-and-thread Sideoats grama (Bouteloua curtipendula) Threadleaf sedge Needleleaf sedge Phlox Wild buckwheat Lupine (Lupinus spp.)	Increase in weeds and annual grasses, especially lupine and cheatgrass biome.	3.5 A/AUM	3.0 A/AUM
14	Sagebrush-Saltbush	Sagebrush Nuttall saltbush (Atriplex nuttalli) Western wheatgrass Blue grama	Plains pricklypear Black greasewood (Sarcobatus vermiculatus) Broom snakeweed Plains reedgrass Bluebunch wheatgrass Needle-and-thread Sandberg bluegrass Green needlegrass Indian ricegrass (Oryzopsis hymenoides) Threadleaf sedge	Increase in plains prickly-pear and annual weeds, with decrease in perennial grasses	7.0 A/AUM	6.0 A/AUM

TABLE 4-5
(Cont.)

Type No.	Name	Principal Forage Species	Other Common Species	Overgrazing Indicators	Grazing Capacity	
					Present	Potential
15	Prairie County Grassland	Threadleaf sedge Needle-and-thread Blue grama	Broom snakeweed Plains pricklypear Sandberg bluegrass Western wheatgrass Prairie junegrass Plains reedgrass Green neelegrass Plains muhly Bluebunch wheatgrass Needleleaf sedge Scarlet globemallow Goosefoot (Chenopodium spp.) Stockseed (Lappula spp.)	Increase in annual weeds, plains pricklypear, and broom snakeweed, with a decrease in needle-and-thread.	3.5 A.AUM	3.0 A/AUM
17	Ponderosa Pine Savannah	Western wheatgrass Bluebunch wheatgrass Blue grama	Rocky mountain juniper Skunkbrush sumac Common snowberry (Symphoricarpos albus) Plains pricklypear Sandberg bluegrass			
18	Northern Grassland	Blue grama Needle-and-thread Western wheatgrass	Broom snakeweed Fringed sagewort Plains pricklypear Rose (Rosa spp.) Skunkbrush sumac Creeping juniper (Juniperus horizontalis) Plains muhly Sandberg bluegrass Green needlegrass Threadleaf sedge Needleleaf sedge Phlox Scarlet globemallow Woolly plantain (Plantaga purshii) Wild buckwheat	Increase in plains prickly-pear, fringed sagewort, snakeweed, and weeds. Decrease in needle-and-thread.	2.5 A/AUM	2.0 A/AUM

TABLE 4-5
(Cont.)

Type No.	Name	Principal Forage Species	Other Common Species	Overgrazing Indicators	Grazing Capacity	
					Present	Potential
19	Badlands Grassland	Blue grama Western wheatgrass Needle-and-thread	Broom snakeweed Sagebrush Plains pricklypear Silver sagebrush Rabbitbrush Nuttall saltbush Creeping juniper Needle-and-thread Buffalograss (Buchloe daclyloides) Sandberg bluegrass Bluebunch wheatgrass Plains muhly Little bluestem Green needlegrass Prairie sandreed (calamovilfa longifolia) Phlox Wild buckwheat Scarlet globemallow Lambsquarter goosefoot (Chenopodium albium)	Increase in sagebrush, plains pricklypear, broom snakeweed, and other shrubs. Increase in weeds, with marked decrease in needle-and-thread.	5.5 A/AUM	5.0 A/AUM
20	Southeastern Grassland	Blue grama Western wheatgrass Threadleaf sedge	Big sagebrush (Artemisia tridentata) Silver sagebrush Fringed sagewort Nuttall saltbush Plains pricklypear Sandberg bluegrass Needle-and-thread Thickspike wheatgrass (Agropyron dasystachyum) Bluebunch wheatgrass Streambank wheatgrass (Agropyron riparium) Prairie junegrass	Increase in sagebrush, fringed sagewort, plains pricklypear, and weeds.	3.0 A/AUM	2.5 A/AUM

TABLE 4-5
(Cont.)

Type No.	Name	Principal Forage Species	Other Common Species	Overgrazing Indicators	Grazing Capacity	
					Present	Potential
20	Southeastern Grassland (cont.)		Plantain Scarlet globemallow Wild onion (Allium spp.) Biscuitroot (Lomatium spp.)			
21	Undifferentiated Stream and Lake Bottoms	Western wheatgrass Blue grass Cheatgrass brome (Bromus tectorum)	Cottonwood (Populus spp.) Willows (Salix spp.) Rose Sagebrush Silver sagebrush Rabbitbrush Common Snowberry Silver buffaloberry (Shepherdia argentea) Needle-and-thread Blue grama Saltgrass (Distichlis spp.) Lambsquarter goosefoot Sunflower (Helianthus spp.) Stickseed Plantain	Increase in sagebrush, plains pricklypear, broom snakeweed, cheatgrass brome, and weeds.	3.0 A/AUM	2.0 A/AUM
22	Sandy Grassland	Needle-and-thread Prairie sandreed Threadleaf sedge	Bluebunch wheatgrass Indian ricegrass Blue grama Prairie junegrass Sand bluestem (Andropogon hallii) Sand dropseed (Sprobalus cryptandrus)	Japanese brome (Bromus joponicus) Stickgrass (Eragrostis cilianensis) Six week fescue (Vulpia octoflora) Golden-aster (Aster spp.) Broom snakeweed Fringed sagewort Fleafaire Erigeron spp.	5.5 A/AUM	2.5 A/AUM
	SOURCE: Payne 1963					

TABLE 4-5
MAJOR VEGETATIVE TYPES WITHIN THE STUDY AREA

South Dakota

Type No.	Name	Principal Forage Species	Other Common Species	Overgrazing Indicators	Grazing Capacity	
					Present	Potential
3	Wheatgrass-Needlegrass	Western wheatgrass Needle-and-thread Little bluestem	Prairie sandreed Green needlegrass Plains muhly Spanishclover deernetch (Lotus purshianus)	Increases in sedges, blue grama, threeown (Aristeda spp.) and fringed sagewort.	3.0 A.AUM	2.0 A/AUM
4	Wheatgrass	Wheatgrasses	Green needlegrass Wild onion	Decrease in perennial grasses and increases of pricklypear, common sunflower, annuals, saltbush, and other forbs.	3.3 A/AUM	2.5 A/AUM
5	Wheatgrass-Gramagrass	Western wheatgrass Green needlegrass Blue grama Threadleaf sedge	American vetch (Vicici americanna) Scarlet globemallow Black sampson (Echinacea angustifolia) Scurfpea (Psoralea spp.) Wild onion Wild parsley (Lomatium spp.)	Increases of threeown, blue grama, buffalograss, pricklypear, and fringed sagewort. Includes Japanese biome and curlycup gumweed.		
6	Wheatgrass-Gramagrass-Buffalograss (Badlands)	Blue grama Western wheatgrass Buffalograss Sideoats grama	Rocky mountain juniper Ponderosa pine Little bluestem	Increase in needle-and-thread, blue grama, buffalograss, and sedges.	2.7 A/AUM	2.4 A/AUM
7	Sagebrush-Grass	Western wheatgrass Montana wheatgrass (Agropyron albicons) Big sagebrush	Nuttall saltbush Greasewood Blue grama Sandberg bluegrass Prairie junegrass Buttlebrush squirreltail (Sitanian hystrix)	Decrease in palatable perennial grasses with increase in shrubby species.	3.5 A/AUM	2.7 A/AUM

TABLE 4-5
(Cont.)

Type No.	Name	Principal Forage Species	Other Common Species	Overgrazing Indicators	Grazing Capacity	
					Present	Potential
8	Pine-Savannah	Little bluestem Big bluestem Prairie dropseed (Sporobalus heterolepis)	Ponderosa pine Plains muhly Blue grama Hairy grama (Boutelova hirsuta) Sideoats grama Switchgrass (Ponicum vircjatum) Indian grass (Sorghastrum nutans) Leadplant (Amorpha canesiens	Increase in Kentucky bluegrass (Poa pretenies), woolly verbena (Verbina stricta), velvet mullin (Verbarcum spp.), broom snakeweed, and fringed sagewort.	2.2 A/AUM	1.5 A/AUM
9	Black Hills Pine Forest	Kentucky bluegrass sedges	Kinnikinick (Arctoslaphylas uva-vrsi) Snowberry Chokecherry (Prunus virginians) Ponderosa pine Paper birch (Betuea papyriflera) Aspen (Populus spp.) Willows	No data	2.2 A/AUM	1.7 A/AUM

SOURCE: South Dakota Rangeland Resources 1977

WATER

Surface Water

The study area contains several large tributary river basins of the Missouri River. These include the Musselshell and Yellowstone in Montana and the Grand, Moreau, Cheyenne, and White in South Dakota. Figure 4-12 shows the location of river basins and gaging stations discussed below.

The Musselshell River is the western boundary of the district between Melstone, Montana, and Fort Peck Reservoir. The total drainage area of the Musselshell is about 9,000 square miles with about 1,000 square miles located in the district. Data collected by the U.S. Geological Survey indicates that the mean streamflow at Mosby, Montana, is 265 cfs (cubic feet per second). The salinity of the river is in the 1,400-2,900 mg/l TDS (total dissolved solids) range depending upon season and streamflow. Water from the Musselshell is primarily used for irrigation, fish and wildlife, and livestock watering.

The Yellowstone River is the major river in the Montana portion of the study area. The total drainage area, as measured at Sidney, Montana, is 69,100 square miles with about 19,000 square miles located in the district. According to U.S. Geological Survey data at Sidney, mean streamflow is 13,090 cfs and the TDS ranges from 300-700 mg/l. Yellowstone water is used by municipalities, fish and wildlife, industry, irrigators, and livestock.

The Tongue River and Powder River, two significant tributaries of the Yellowstone River, originate in Wyoming and flow northward into the Yellowstone.

The Tongue River at Miles City, as recorded by the U.S. Geological Survey, has a mean flow of 440 cfs and TDS values ranging from 250 to 700 mg/l. Water uses from the Tongue include irrigation, fish and wildlife, and livestock.

The Powder River near Locate, Montana, has a mean streamflow of 615 cfs and average TDS range of 1,000-2,000 mg/l. Water uses include some irrigation, fish and wildlife, and livestock watering.

The remaining drainage basins in the Montana portion of the district are smaller and ephemeral or intermittent.

Most of the water in the rivers does not originate within the study area. Annual precipitation in eastern Montana is between 13 to 22 inches. Nearly all of this precipitation is evapotranspirated and does not enter the major river systems. That which does (an estimated 1.2 inches) dissolves salts and carries sediment into the receiving waters.

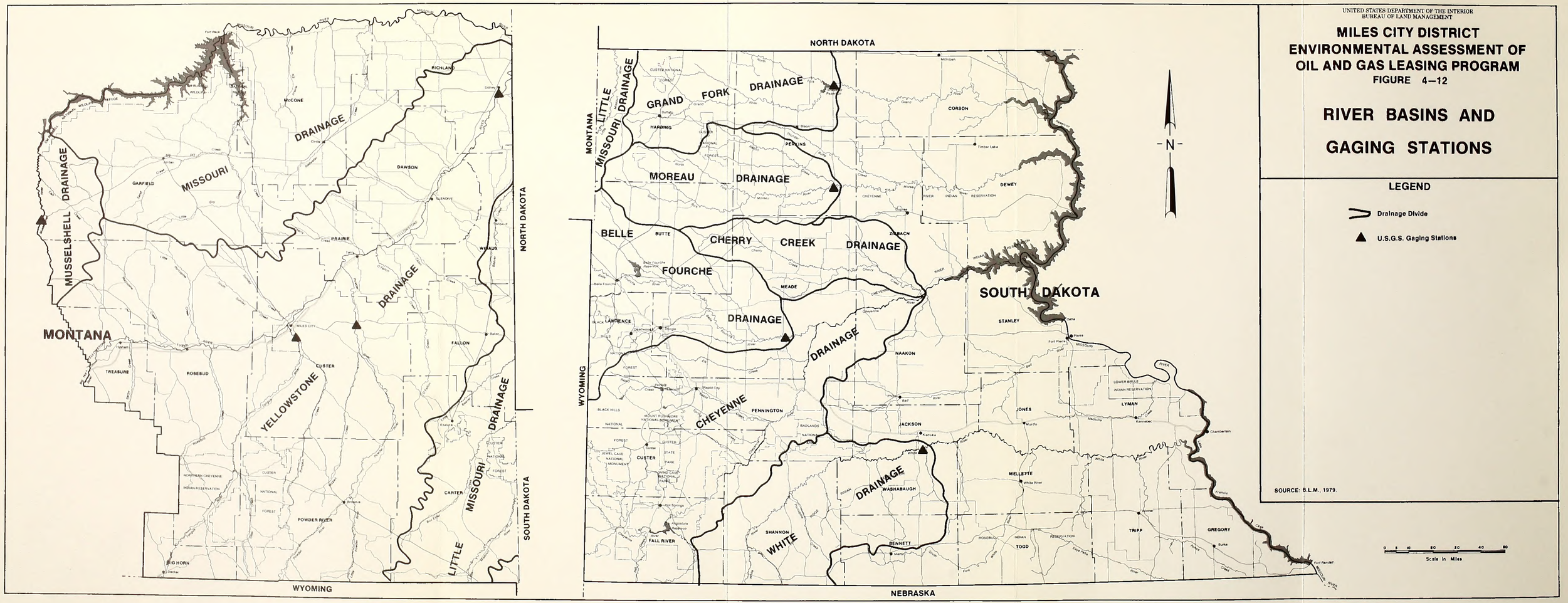
All of the major river systems in western South Dakota (Grand, Moreau, Cheyenne, and White) are direct tributaries of the Missouri. The Grand River is located in the northwestern part of South Dakota with a total drainage area of about 3,100 square miles, as measured from Shadehill, South Dakota. The majority of the drainage system is located in the study area. U.S. Geological Survey records indicate an average streamflow of 114 cfs. Water uses include irrigation, fish and wildlife, and livestock watering.

The Moreau River has a drainage area of 2,600 square miles as measured at Faith, South Dakota. All of the drainage basin is within the study area. Streamflow records indicate a mean flow of 134 cfs. Known water uses from the Moreau include irrigation, fish and wildlife, and livestock watering.

The Cheyenne River is the largest tributary of the Missouri in the South Dakota portion of the study area (i.e., western half of South Dakota). Total drainage area is 23,900 square miles as measured at Cherry Creek. About 16,000 square miles of this drainage (66%) are located in the South Dakota portion of the study area. U.S. Geological Survey records indicate a mean discharge of 824 cfs and TDS values of between 750-2,300 mg/l. Water uses include irrigation, fish and wildlife, and livestock watering.

The Belle Fourche River is a significant tributary of the Cheyenne River. Records indicate an average streamflow of 365 cfs at Elm Springs. Water uses include irrigation, fish and wildlife, and livestock watering.

The White River is located in southwestern South Dakota. Total drainage area is 5,000 square miles at Kodaka, South Dakota, with about 33% located in the study area. Streamflow records indicate an average flow of 279 cfs. Water uses include irrigation, fish and wildlife, and livestock watering.


MONTANA
NORTH DAKOTA
SOUTH DAKOTA
WYOMING
NEBRASKA
MUSSELSHELL DRAINAGE
MISSOURI DRAINAGE
YELLOWSTONE DRAINAGE
LITTLE MISSOURI DRAINAGE
GRAND FORK DRAINAGE
MOREAU DRAINAGE
BELLE FOURCHE DRAINAGE
CHERRY CREEK DRAINAGE
WHITE DRAINAGE
WASHABAUGH DRAINAGE
N
RICHLAND
McCONE
DAWSON
GARFIELD
PRAIRIE
WIBAUX
FALLON
CARTER
TREASURE
ROSEBUD
CUSTER
POWDER RIVER
BIG HORN
HARDING
PERKINS
CORSON
DEWEY
ZIEBACH
BUTTE
MEADE
LAWRENCE
STANLEY
NAAKON
PENNINGTON
JACKSON
JONES
LYMAN
MELLETTE
TRIPP
GREGORY
TODD
SHANNON
BENNETT
FALL RIVER
CHEYENNE
INDIAN RESERVATION
BLACK HILLS
NATIONAL FOREST
RADLANDS NATIONAL MONUMENT
JEWEL CAVE NATIONAL MONUMENT
WIND CAVE NATIONAL PARK
MOUNT RUSHMORE NATIONAL MEMORIAL
Fort Peck
Glasgow
Malta
Havre
Chinook
Big Timber
Livingston
Billings
Miles City
Glendive
Sidney
Wolf Point
Culbertson
Scobey
Plentywood
Circle
Jordan
Winnett
Roundup
Forsyth
Hysham
Colstrip
Hardin
Lodge Grass
Crow Agency
Broadus
Ekalaka
Alzada
Belle Fourche
Sturgis
Rapid City
Custer
Hot Springs
Edgemont
Oelrichs
Buffalo
Gillette
Newcastle
Lusk
Douglas
Casper
Lander
Riverton
Thermopolis
Worland
Basin
Greybull
Cody
Powell
Meeteetse
Shoshoni
Dubois
Jackson
Pinedale
Big Piney
Kemmerer
Evanston
Lyman
Mountain View
Green River
Rock Springs
Rawlins
Baggs
Saratoga
Encampment
Riverside
Walcott
Medicine Bow
Hanna
Elk Mountain
Arlington
Laramie
Wheatland
Torrington
Lingle
Fort Laramie
Guernsey
Hartville
Lusk
Manville
Lusk
Harrison
Hemingford
Alliance
Crawford
Chadron
Gordon
Rushville
Gering
Scottsbluff
Bridgeport
Sidney
Kimball
Potter
Dix
Big Spring
Ogallala
Sutherland
North Platte
Cozad
Gothenburg
Lexington
Elwood
Holdrege
Minden
Kearney
Hastings
Grand Island
Aurora
Central City
Fullerton
Columbus
Schuyler
David City
Seward
York
Fairmont
Geneva
Fremont
Blair
Tekamah
Omaha
Council Bluffs
Nebraska City
Falls City
Auburn
Beatrice
Fairbury
Hebron
Superior
Franklin
Red Cloud
Blue Hill
Hardy
Nelson
Superior
Oxford
Cambridge
McCook
Indianola
Culbertson
Trenton
Stratton
Hayes Center
Wauneta
Imperial
Chase
Grant
Hyannis
Thedford
Valentine
Merriman
Cody
Ainsworth
Long Pine
Bassett
Newport
Atkinson
O'Neill
Stuart
Ewing
Neligh
Oakdale
Norfolk
Madison
Wayne
Pierce
Plainview
Creighton
Niobrara
Verdigre
Spencer
Bloomfield
Wausa
Randolph
Laurel
Wakefield
Allen
Dakota City
Homer
Hubbard
Jackson
Ponca
Dixon
Concord
Coleridge
Wynot
Hartington
Crofton
Lesterville
Yankton
Vermillion
Elk Point
Beresford
Alcester
Hudson
Canton
Lennox
Harrisburg
Sioux Falls
Tea
Dell Rapids
Garretson
Brandon
Baltic
Hartford
Humboldt
Canistota
Salem
Parker
Freeman
Marion
Menno
Tabor
Wagner
Lake Andes
Geddes
Platte
Mitchell
Corsica
Letcher
Woonsocket
Huron
Wessington Springs
Miller
Highmore
Harrold
Onida
Gettysburg
Ashton
Redfield
Aberdeen
Groton
Webster
Watertown
Clear Lake
Milbank
Big Stone City
Sisseton
Wilmot
Britton
Eureka
Mobridge
Selby
Java
Gettysburg
Pierre
Fort Pierre
Oahe
Chamberlain
Kennebec
Presho
Winner
Colome
Burke
Gregory
Fairfax
Bonesteel
Herrick
Tripp
Dallas
Carter
Martin
Winner
Rosebud
Mission
Parmelee
Kadoka
Interior
Wall
Philip
Midland
Cottonwood
Belvidere
Scenic
Quinn
Wasta
Rapid Valley
Piedmont
Sturgis
Hill City
Keystone

Ground Water

Ground water resources are found throughout the study area. The depth of ground water varies greatly from a few feet in unconsolidated alluvial flood plain deposits to several hundred feet in higher elevation sandstones and shales. The chemical quality of ground water generally reflects the minerology of the rock where the water is found.

The ground waters of primary concern in the study area are near surface waters associated with flood plain alluviums. Flood plain alluviums are found adjacent to nearly every stream but are more significant along major rivers. The alluvium consists of stratified gravels, sands, and silts which, in most cases, have high water storage capabilities. The water in the alluvium is closely connected with that in the adjacent stream. During peak streamflows, water is stored in the alluvium and during low streamflow water is discharged from the alluvium into the stream.

The ground waters associated with the consolidated rocks, sandstones, limestones, and shales are generally found at greater depths than ground waters associated with alluvium. With few exceptions, there is less of an immediate relationship between streamflow and ground water in these formations than there is between streamflow and alluvial ground water. These deeper aquifers are an important source of water for rural domestic use.

ANIMALS

The oil and gas study area encompasses 20,218,300 acres in eastern Montana and western South Dakota. The Vegetation section of the Assessment defines 11 broad vegetative types in Montana and 7 in western South Dakota. These vegetative types or combinations provide important year-round or seasonal habitat for 67 species of mammals, 225 known species of birds, 52 species of fishes, and 16 known species of amphibians and reptiles (Appendix 4-2). Also included are the endangered black-footed ferret, peregrine falcon, whooping crane, and bald eagle.

Furthermore, the study area provides important rangeland for Montana's and South Dakota's livestock industries. There are currently 1,895 livestock operators using BLM administered grazing lands in the district. BLM administered lands provide forage for approximately 154,130 cattle and horses, and 83,507 sheep and goats in the area, in some cases on a seasonal use basis.

Endangered and Threatened Species

Federally listed endangered species and their habitats are of special concern when making resource decisions about public lands.

The black-footed ferret (*Mustela nigripes*) has been recently observed in Carter County, Montana, and Mellette and Bennett Counties, South Dakota. However, occurrences in other parts of their historic range (including much of eastern Montana and all of western South Dakota except Lawrence County) are highly possible. Figure 4-13 shows the location of these counties within the study area. The ferret relies totally upon prairie dog towns for existence. Consequently, all known prairie dog town locations are considered potentially suitable habitat for the ferret.

The peregrine falcon has historically nested in the study area. Cliffs, frequently overlooking water, are the most commonly used areas for nest sites; however, the peregrines occasionally nest in other areas as well. The nest sites are highly traditional, linking generations of peregrine falcons to the same nest site.

The endangered bald eagle is a known nesting raptor in the study area (Figure 4-14); ten active nests have been identified as of 1979. Eagles generally select the largest trees in the immediate area for nesting. Bald eagles of the northern states and Canada move southward during the winter months to gather along open water rivers and lakes where food is available. The Yellowstone, Tongue, and Missouri Rivers are traditional locations of wintering eagle concentrations within the study area.

No whooping cranes are known to nest within the boundaries of the study area and no major staging areas are found there. However, a portion of the migration corridor of the whooping cranes does lie within the study area, and incidental sightings of the cranes have been recorded (Appendix 4-3), although it is not known whether these resting sites are traditional.

The northern swift fox is a threatened species in South Dakota. It is widespread in the western part of the state with recent, confirmed sightings in Corson, Perkins, Fall River, Shannon, Haakon, and Jackson Counties. Occurrence of swift foxes would most likely be in its historic range; a belt of rolling hills in short-grass and mid-grass prairie running diagonally (SW-NE) across the western half of the state. Within its distribution, prairie dog towns are important habitats of the northern swift fox.

Big Game Species

Elk

The elk herds within the district are found almost exclusively on lands under jurisdiction of the Fish and Wildlife Service and the Forest Service.

Bighorn Sheep

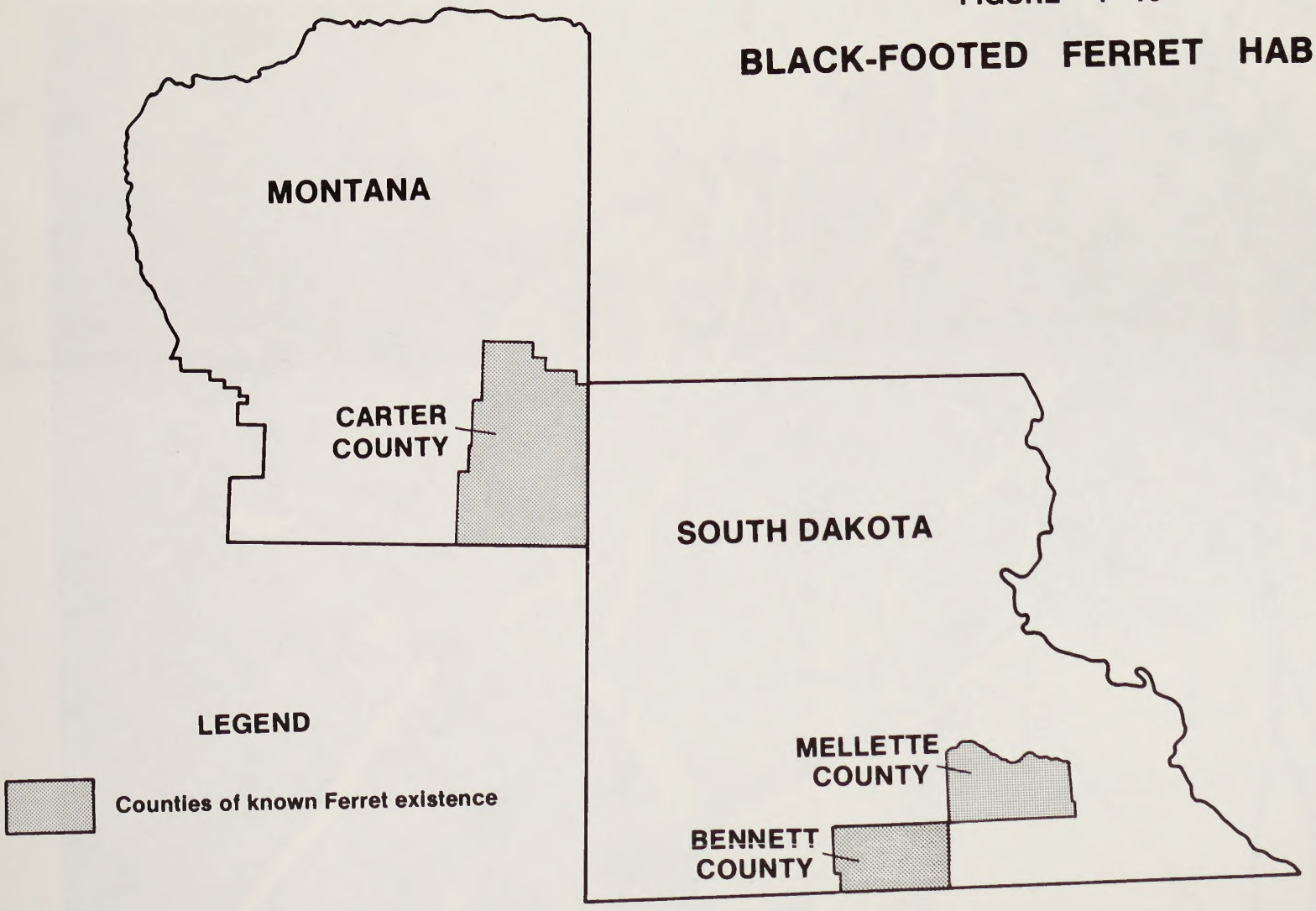
A small, isolated population of bighorn sheep is located in the Blue Hills area east of Miles City (Figure 4-15). In 1958, 13 bighorns were transplanted there from the Sun River area in Montana by the Montana Fish and Game Department. The rocky, isolated hills proved to be suitable habitat for the sheep. The herd increased and now provides a small but huntable population of approximately 40-50 animals.

Deer

Mule deer are found throughout the area and are typically associated with the open grassland-

FIGURE 4—13

BLACK-FOOTED FERRET HABITAT



SOURCE: Montana Dept. of Fish, Wildlife, and Parks, 1979 and South Dakota Dept. of Game, Fish, and Parks, 1979.



Figure 4-14
Nesting Bald Eagle
SOURCE: U.S. Fish and Wildlife Service

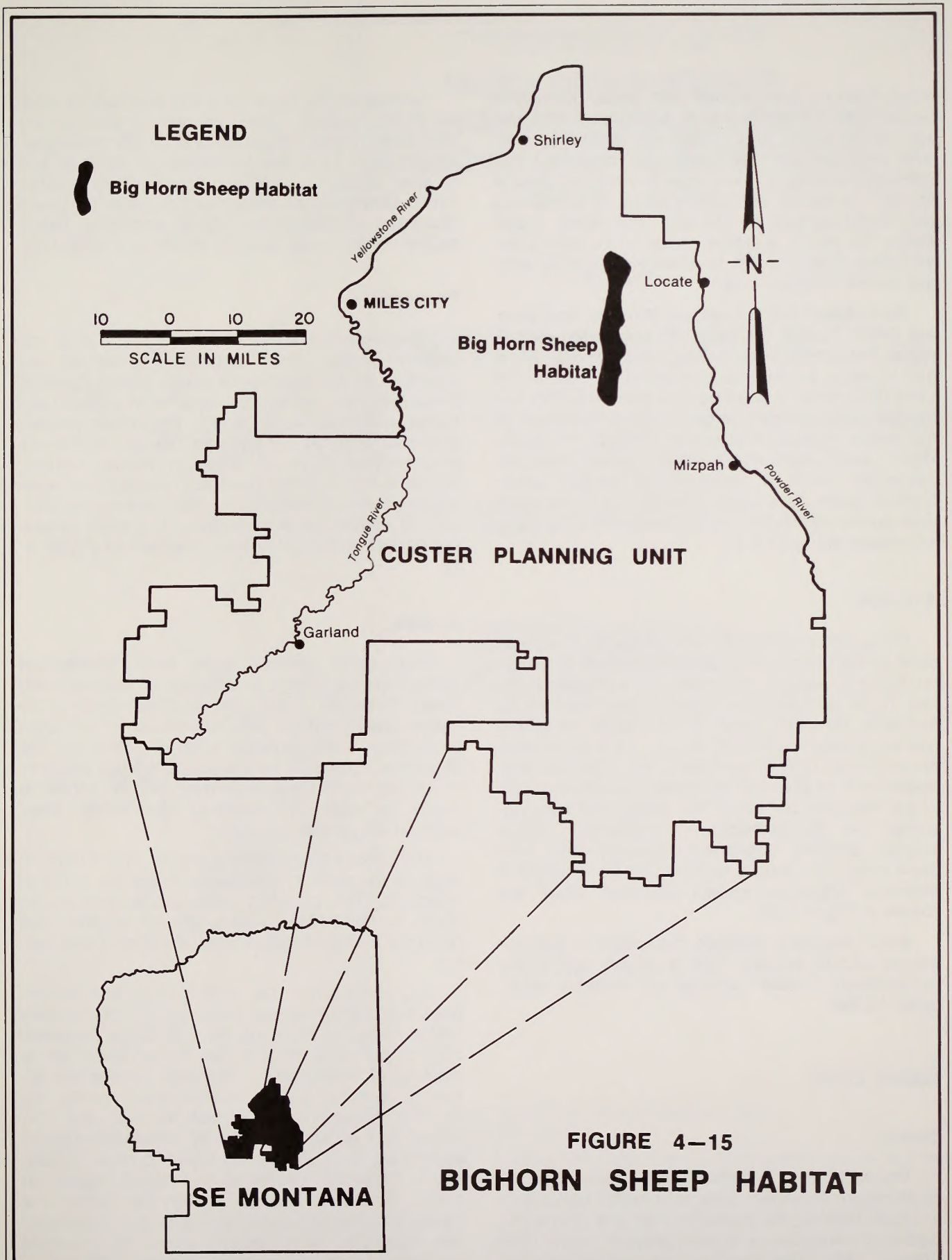


FIGURE 4—15

BIGHORN SHEEP HABITAT

SOURCE: Miles City District B.L.M., 1979.

shrub habitats interspersed with timber or broken terrain. Other habitats, such as riparian bottoms, agricultural areas, and forests are utilized as well, with some of the use being only seasonal. The carrying capacity for mule deer in the study area is stongly correlated with winter range. It provides a substantial portion of the diet and cover needs during the winter, a critical period in the deer's life. Wintering areas known to exist in the study area are shown in Figure 4-16.

White-tailed deer of eastern Montana and western South Dakota are generally associated with riparian bottomlands surrounding major lakes, rivers, and streams. An isolated population is found in the Long Pines area of southeastern Montana. This is a rugged, open ponderosa pine area with fingers of deciduous vegetation scattered through the pines. Woody draws that extend into the upland areas are seasonally used by whitetails for escape cover. Several areas have been identified as white-tailed deer areas; distribution and general wintering areas are shown in Figure 4-17.

Antelope

Prong-horned antelope can be found throughout most of the open, rolling grassland-sagebrush habitat found in eastern Montana. An estimate in the late 1800s of 2,500,000 antelope was reported for Montana. However, much of the native rangeland has since been cultivated, and by 1965 there were an estimated 75,000 antelope in the state. An estimated 40% of the state antelope population occurs in the Montana portion of the study area (see Appendix 4-4 for estimation methodology). Winter habitat, primarily sagebrush relatively free from snow cover, is a crucial requirement for antelope in Montana. Important known wintering areas are shown in Figure 4-18.

South Dakota's antelope population is approximately 33,500 animals. This is largely due to the considerably smaller acreage of available sagebrush habitat.

Game Birds

Turkey

The wild turkey is probably not a native species of Montana. However, after successful transplants in South Dakota, the Montana Fish and Game Department undertook a similar program from 1954 through 1957. The program was very successful; the turkeys flourished and provided a huntable population and transplanting stock for other areas.

Turkeys in the study area are generally restricted to the rugged, open, ponderosa pine forests with small, grassy openings and brushy drainages. Mature pine trees are important for roosting and smaller, denser stands are important for escape cover. During winter, the turkeys are found in lower drainages of deciduous cover. Important turkey habitat to the study area is shown in Figure 4-19.

Pheasant

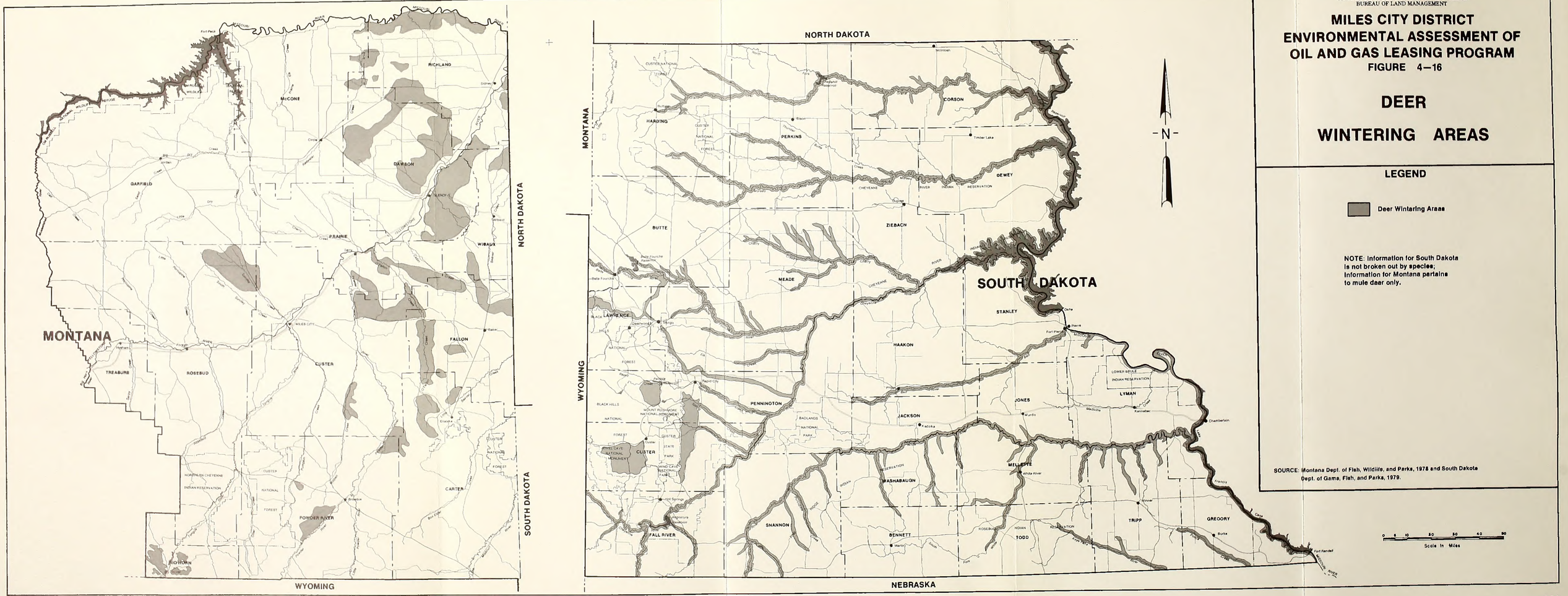
Ring-necked pheasants were introduced in the western states when agricultural practices encroached on the habitats of native grouse species. Pheasants have generally flourished in irrigated agricultural areas, along rivers, and major creeks where farming has not been so intensive that cover is eliminated. A recent study in Wibaux County, Montana, found that pheasant populations were highest in those agricultural areas where interspersion of vegetation was greatest. Important pheasant habitat in the study area is shown in Figure 4-20.

Grouse

Sharp-tailed grouse were once widespread throughout the prairie brushlands of the Northern Great Plains. As settlement occurred, much of its native prairie habitat was altered for small grain production and livestock grazing. Although the sharptails appear to be tolerant to limited amounts of modern agriculture, their most secure habitat is found in relatively unaltered grasslands interspersed with shrub species.

The breeding and nesting period, from March to June, is the most critical period in the life cycle of sharptails. The breeding male grouse attracts females to traditional breeding ground, or leks, and performs a magnificant display of dancing and calling.

In pioneer times, the sage grouse was considered the leading upland game bird in the western states, including Montana. By the 1930s, however, 50% of the birds' original habitat had been lost to agricultural development. The sage grouse are extremely specific in their habitat requirements, depending primarily on sagebrush for their diet. The winter diet of sage grouse is almost exclusively sagebrush. They have been found to move considerable distances in winter to high density sagebrush areas. Sagebrush areas of known high winter use by sage grouse are shown in Figure 4-21. Similar to the sharptails, sage grouse move to traditional breeding grounds in the spring (Figure 4-22). Several high concentrations of strutting grounds have been located in certain portions of the study area.



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MILES CITY DISTRICT ENVIRONMENTAL ASSESSMENT OF OIL AND GAS LEASING PROGRAM

FIGURE 4—16

DEER

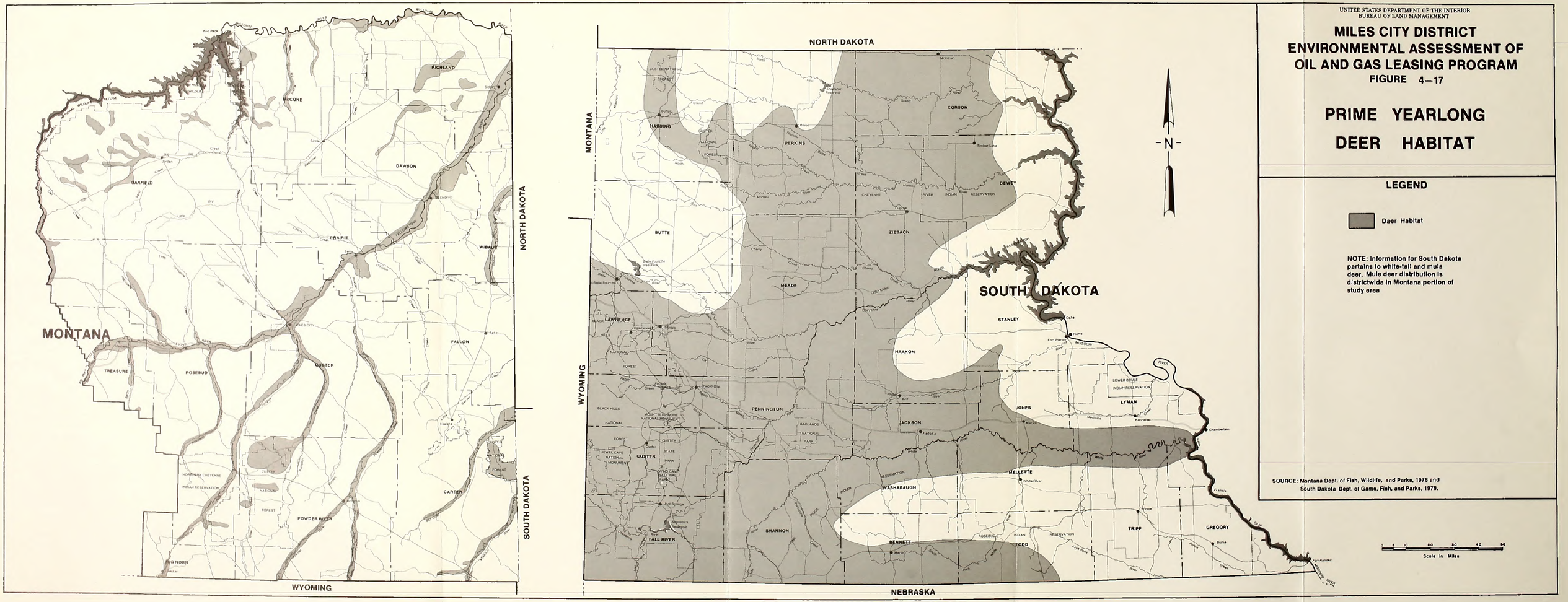
WINTERING AREAS

LEGEND

Deer Wintering Areas

NOTE: Information for South Dakota is not broken out by species; information for Montana pertains to mule deer only.

SOURCE: Montana Dept. of Fish, Wildlife, and Parks, 1978 and South Dakota Dept. of Game, Fish, and Parks, 1979.



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FIGURE 4—17

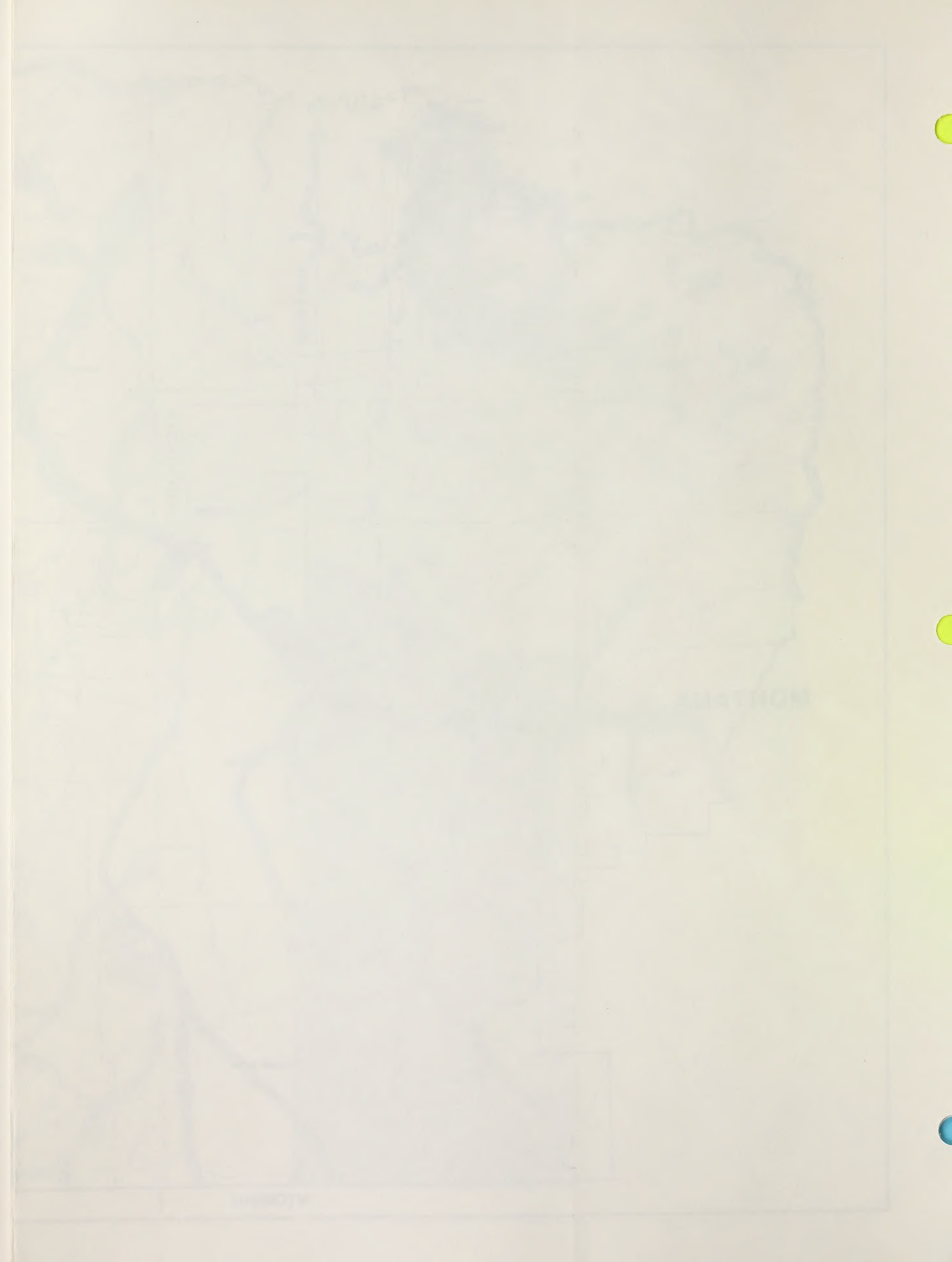
PRIME YEARLONG DEER HABITAT

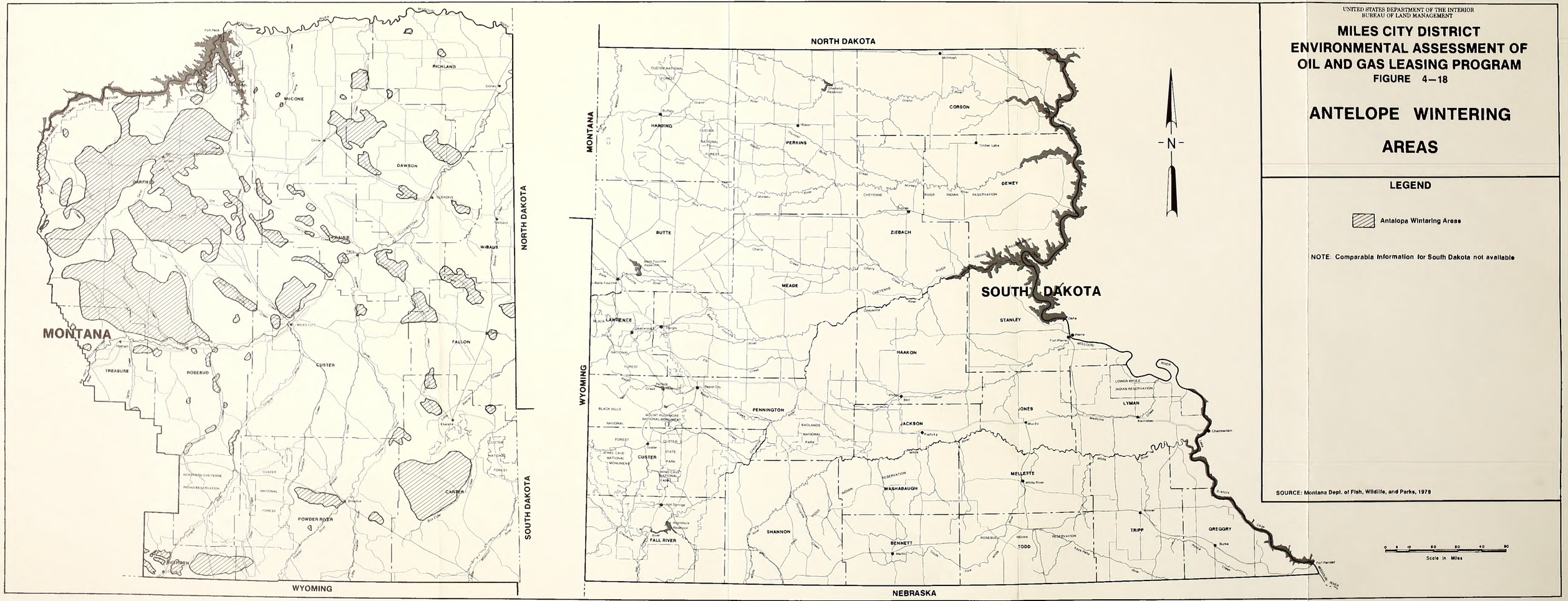
LEGEND

Deer Habitat

NOTE: Information for South Dakota pertains to white-tail and mule deer. Mule deer distribution is districtwide in Montana portion of study area

SOURCE: Montana Dept. of Fish, Wildlife, and Parks, 1978 and South Dakota Dept. of Game, Fish, and Parks, 1979.





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FIGURE 4—18

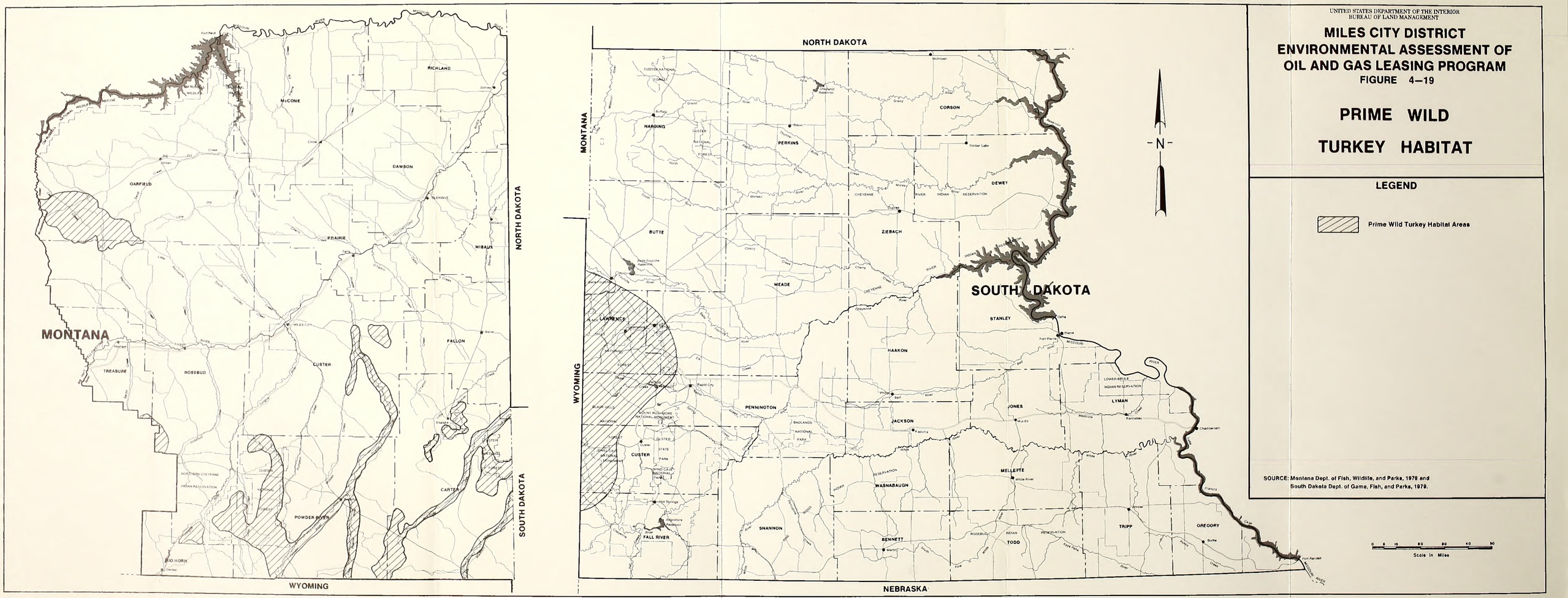
ANTELOPE WINTERING AREAS

LEGEND

Antelope Wintering Areas

NOTE: Comparable information for South Dakota not available

SOURCE: Montana Dept. of Fish, Wildlife, and Parks, 1978



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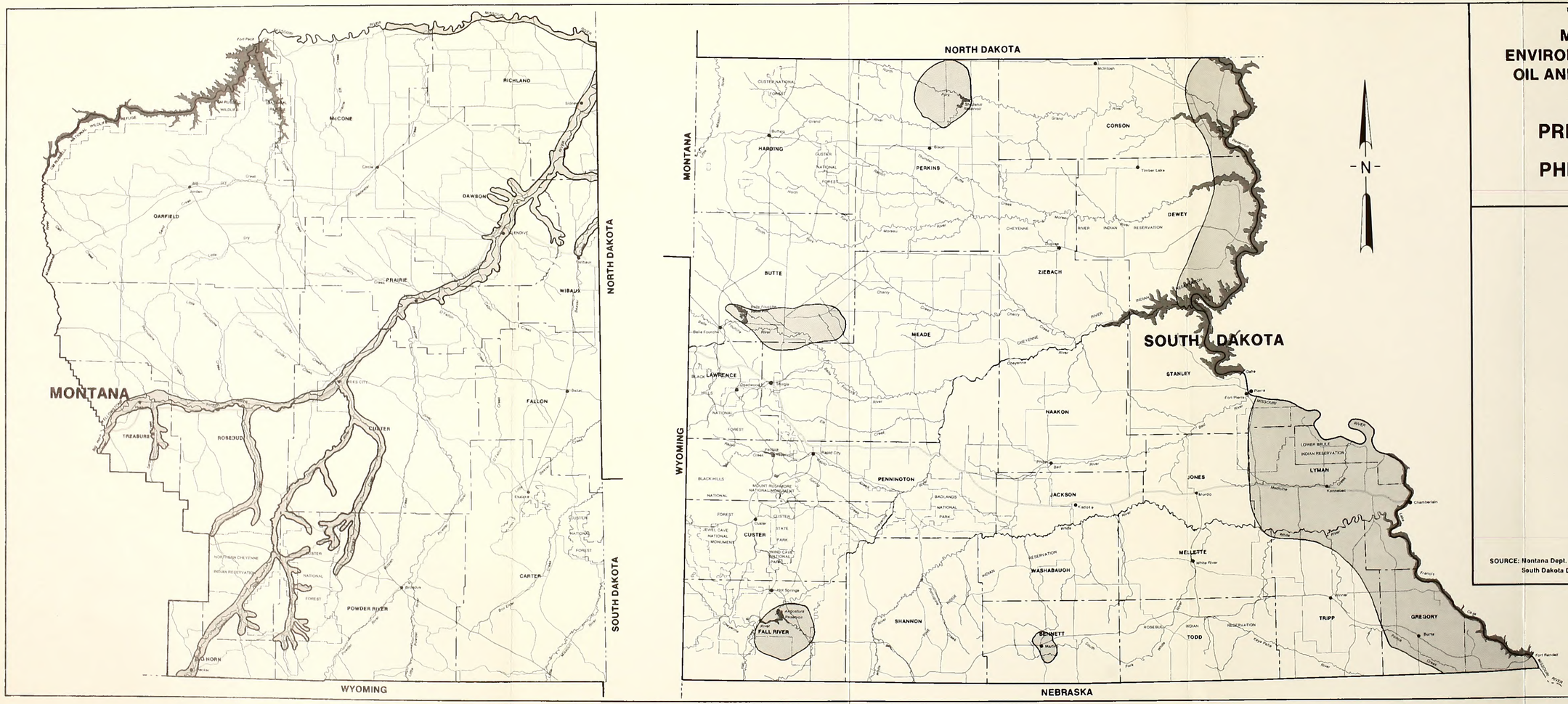
FIGURE 4—19

PRIME WILD TURKEY HABITAT

LEGEND

Prime Wild Turkey Habitat Areas

SOURCE: Montana Dept. of Fish, Wildlife, and Parks, 1978 and South Dakota Dept. of Game, Fish, and Parks, 1979.



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MILES CITY DISTRICT ENVIRONMENTAL ASSESSMENT OF OIL AND GAS LEASING PROGRAM

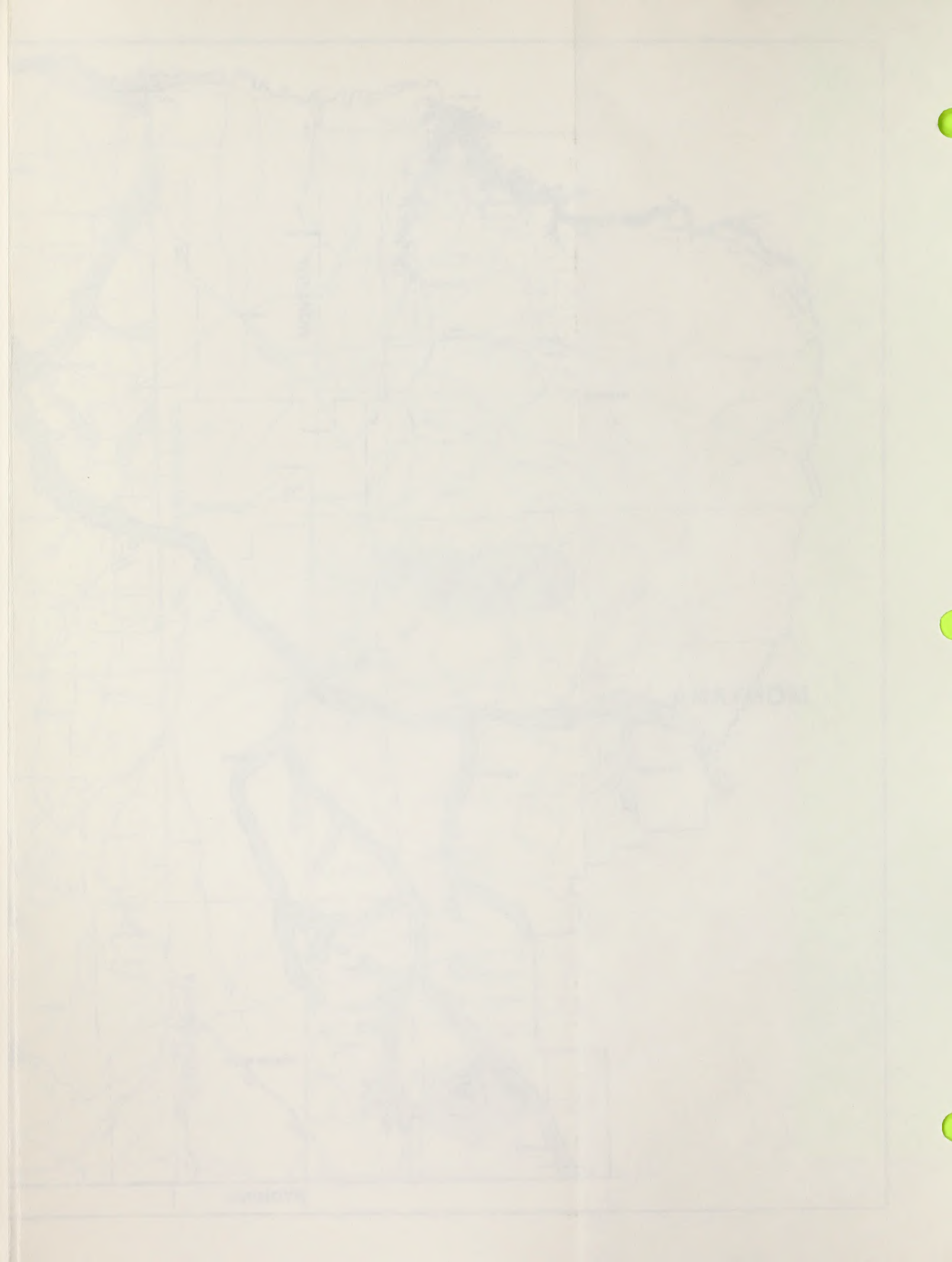
FIGURE 4—20

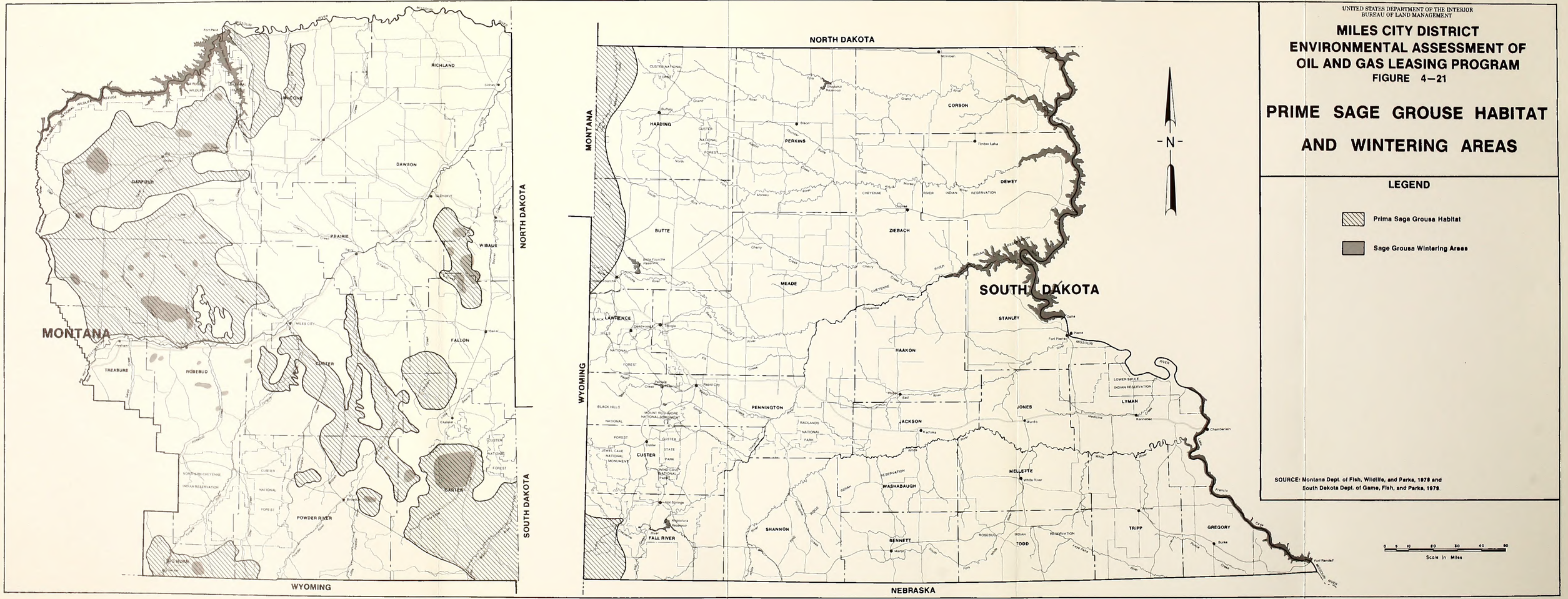
PRIME RING-NECKED PHEASANT HABITAT

LEGEND

Pheasant Habitat

SOURCE: Montana Dept. of Fish, Wildlife, and Parks, 1978 and South Dakota Dept. of Game, Fish, and Parks, 1979.





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MILES CITY DISTRICT ENVIRONMENTAL ASSESSMENT OF OIL AND GAS LEASING PROGRAM

FIGURE 4—21

PRIME SAGE GROUSE HABITAT AND WINTERING AREAS

LEGEND

- Prima Sage Grousa Habitat
- Sage Grousa Wintering Areas

SOURCE: Montana Dept. of Fish, Wildlife, and Parks, 1978 and South Dakota Dept. of Game, Fish, and Parks, 1979.



Figure 4-22

Strutting Sage Grouse

SOURCE: Montana Department of Fish, Wildlife, and Parks

Ducks

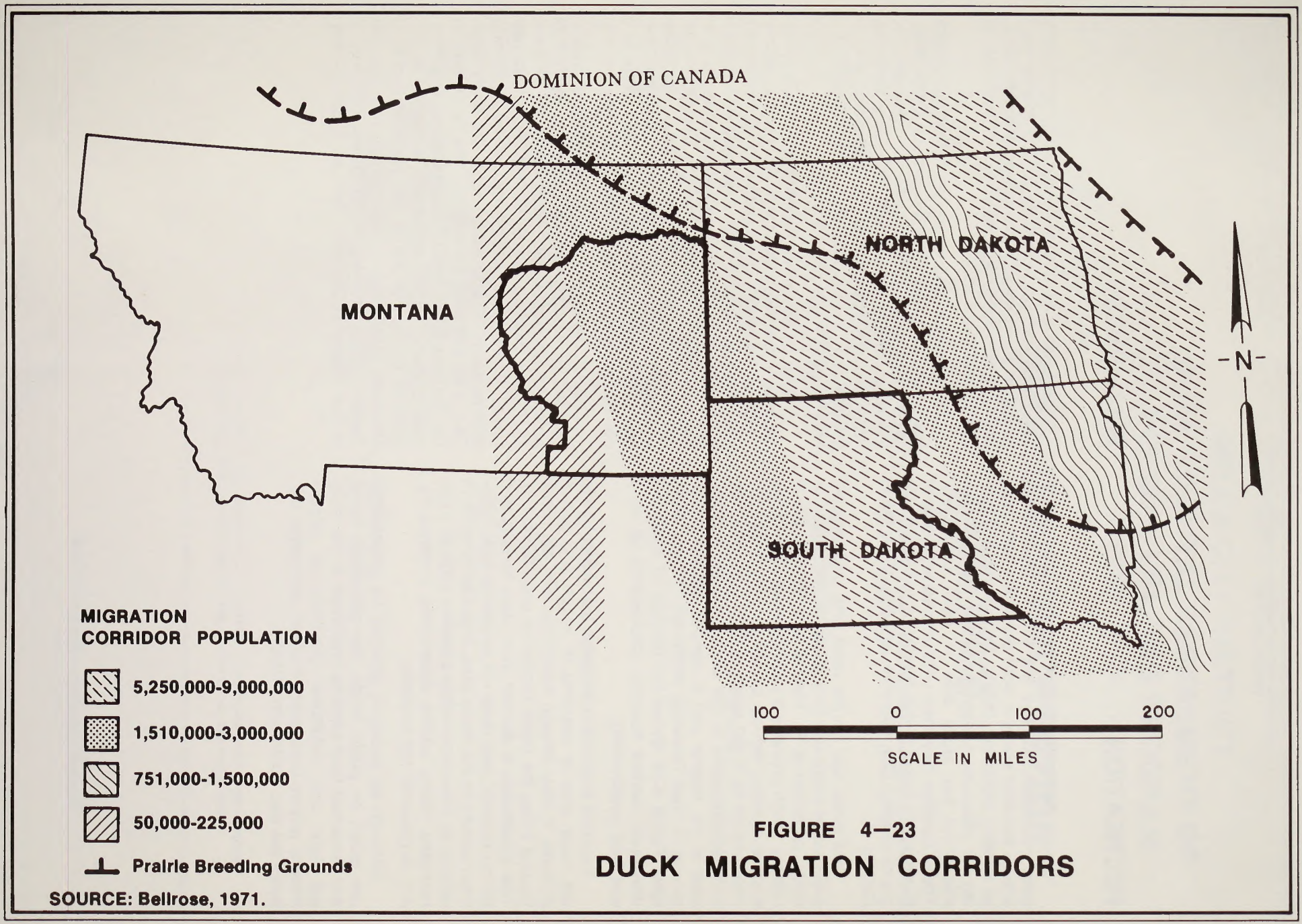
The study area is within the Central Flyway Waterfowl Management Unit, and as such, there are important migration corridors that pass through the area (Figure 4-23). The Prairie Pothole breeding grounds, the most important nesting area for dabbling ducks in North America, are located directly east of the study area. Many of the same characteristics of spring runoff ponds exist in the eastern portion of the study area and provide important habitat for nesting waterfowl. The major rivers and stockponds are also important habitat for resident ducks and provide nesting areas for migrants.

Fish

The fisheries in the Miles City District are primarily of the warm water variety. Ling, sauger, walleye, northern pike, sturgeon, paddlefish, and catfish are found in the Yellowstone, Missouri, Tongue, and Powder Rivers in the District. These fishes move upstream into smaller tributaries to spawn. The paddlefish provides an important recreational resource for eastern Montanans and non-area residents as well. A popular recreation access site is located at Intake Dam where hundreds of fishermen gather to try their skill at snagging when the paddlefish are migrating upstream in the spring. In addition, several stockponds and reservoirs throughout the district have been stcked with northern pike, largemouth bass, perch, walleye, and bluegills.

Cold water trout fisheries within the district are in the Upper Tongue River, Fox Creek, and Fort Peck Reservoir in Montana; and in several streams (predominantly in the Black Hills) in South Dakota. Numerous lakes and small reservoirs in both Montana and South Dakota support trout.

A more detailed description of the important habitat/wildlife features known to exist in the study area can be found in the Miles City District Oil and Gas Map Overlay File which is described in the introduction to Chapter 2.



SOURCE: Bellrose, 1971.

FIGURE 4—23

DUCK MIGRATION CORRIDORS

RECREATION

Due to the rural nature of the study area, developed recreation facilities are limited. Most recreational activities are of a more dispersed form, such as hunting, picnicking, fishing, sightseeing, and driving for pleasure. Urban recreation facilities exist throughout the study area in each community. These facilities vary from unstructured programs of Ekalaka and Baker to the developed recreation programs of Miles City, Glendive, and Spearfish, South Dakota.

BLM lands are, for the most part, undeveloped and receive minor use throughout the study area. A major exception is Ft. Meade near Sturgis, South Dakota, which provides a variety of recreational use such as hunting, fishing, camping, and off-road vehicle use on its 6,700 acres of BLM land. The only BLM developments in the study area are a picnic area at Ft. Meade and a semi-developed campground at Clark Reservoir northwest of Terry, Montana. Figure 4-24 shows the location of additional developed outdoor facilities administered by state and local governments.

Available information indicates that visitor use in the study area is seasonal in nature and occurs primarily in May through November with big game hunting being the major recreation use (Table 4-6). This information is derived from state hunting and fishing records, and does not represent total recreation activity in the study area. Reliable information relating to non-consumptive activities such as rockhounding, hiking, wildlife observation, photography, etc., is presently not available.

Although an excellent potential for recreational use exists on public lands, low population levels and dispersed land patterns contribute to the present light use. Additional problems of access through private lands and increasing landowner closures are also contributing factors.

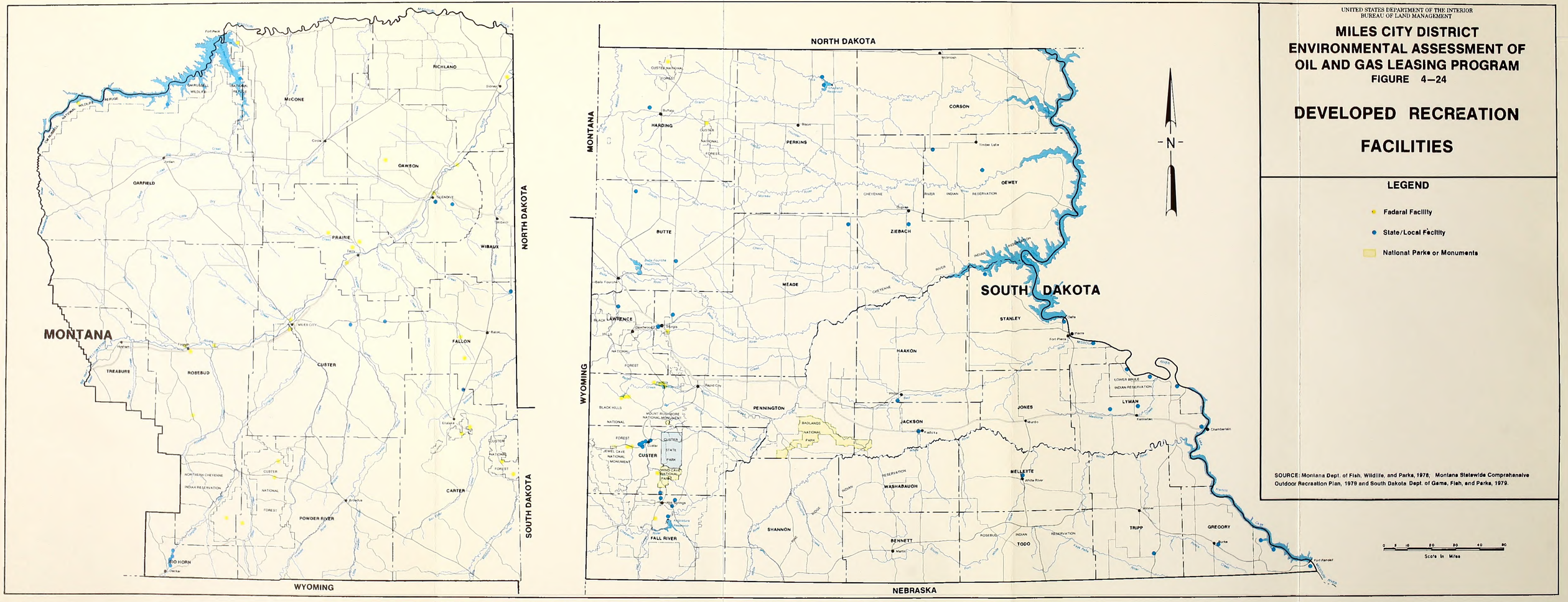
WILDERNESS

The Miles City District is currently conducting wilderness reviews according to procedures contained in the Bureau's Wilderness Review Handbook. A schematic summary of this process is shown in Figure 4-25.

To date, one area within the Miles City District has been identified as a Wilderness Study Area (WSA) as a result of an accelerated inventory for the Northern Tier Pipeline EIS. The Terry Badlands WSA contains approximately 44,500 acres and is located in T. 11, 12, and 13 N., R. 49 and 50 E., MPM (Figure 4-26).

A total of 60 areas containing 749,025 acres have been recommended for an intensive inventory which is scheduled for completion by September 30, 1980 (see Apendix 4-5). A detailed description/evaluation of these areas can be found in the Wilderness Review Program Situation Evaluations for the Miles City District (Inventory Phase - Initial Inventory). These areas are scattered throughout the Montana portion of the District. South Dakota has no areas identified for further wilderness review.

The U.S. Fish and Wildlife Service has recommended six areas containing approximately 70,620 acres for designation as wilderness in the Charles M. Russell National Game Refuge. Forest Service RARE II proposals include two areas containing approximately 21,600 acres within the study area. One area contains 5,000 acres and is located in the Northern Black Hills of South Dakota. The other area contains 16,600 acres and is located in the Ashland Division of the Custer National Forest in Montana. The National Park Service has one wilderness area containing 64,250 acres. This area is in the Badlands National Park in South Dakota.



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MILES CITY DISTRICT ENVIRONMENTAL ASSESSMENT OF OIL AND GAS LEASING PROGRAM

FIGURE 4—24

DEVELOPED RECREATION FACILITIES

LEGEND

- Fadaral Facility
- State/Local Facility
- National Parks or Monuments

SOURCE: Montana Dept. of Fish, Wildlife, and Parks, 1978; Montana Statewide Comprehensive Outdoor Recreation Plan, 1979 and South Dakota Dept. of Game, Fish, and Parks, 1979.

0 5 10 20 30 40 50
Scale In Miles

TABLE 4-6

HUNTING AND FISHING USE SUMMARY

Species	Recreation Days[1/]
Montana[2/]	
Mule Deer	32,665
White-tailed Deer	36,847
Antelope	25,464
Sharp-tailed Grouse	13,200
Sage Grouse	5,900
Ring-necked Pheasant	12,900
Wild Turkey	4,983
Paddle Fish	4,400
Salmonid Fish	75,900
South Dakota[3/]	**[4/]**
Deer (all seasons)	278,190
Antelope (all seasons)	21,999
Grouse	65,650
Ring-necked Pheasant	596,450
Turkey	10,972
Fish	Data not provided

1/ 1976 data; derived from state hunting and fishing records and does not represent total recreational use in the study area.

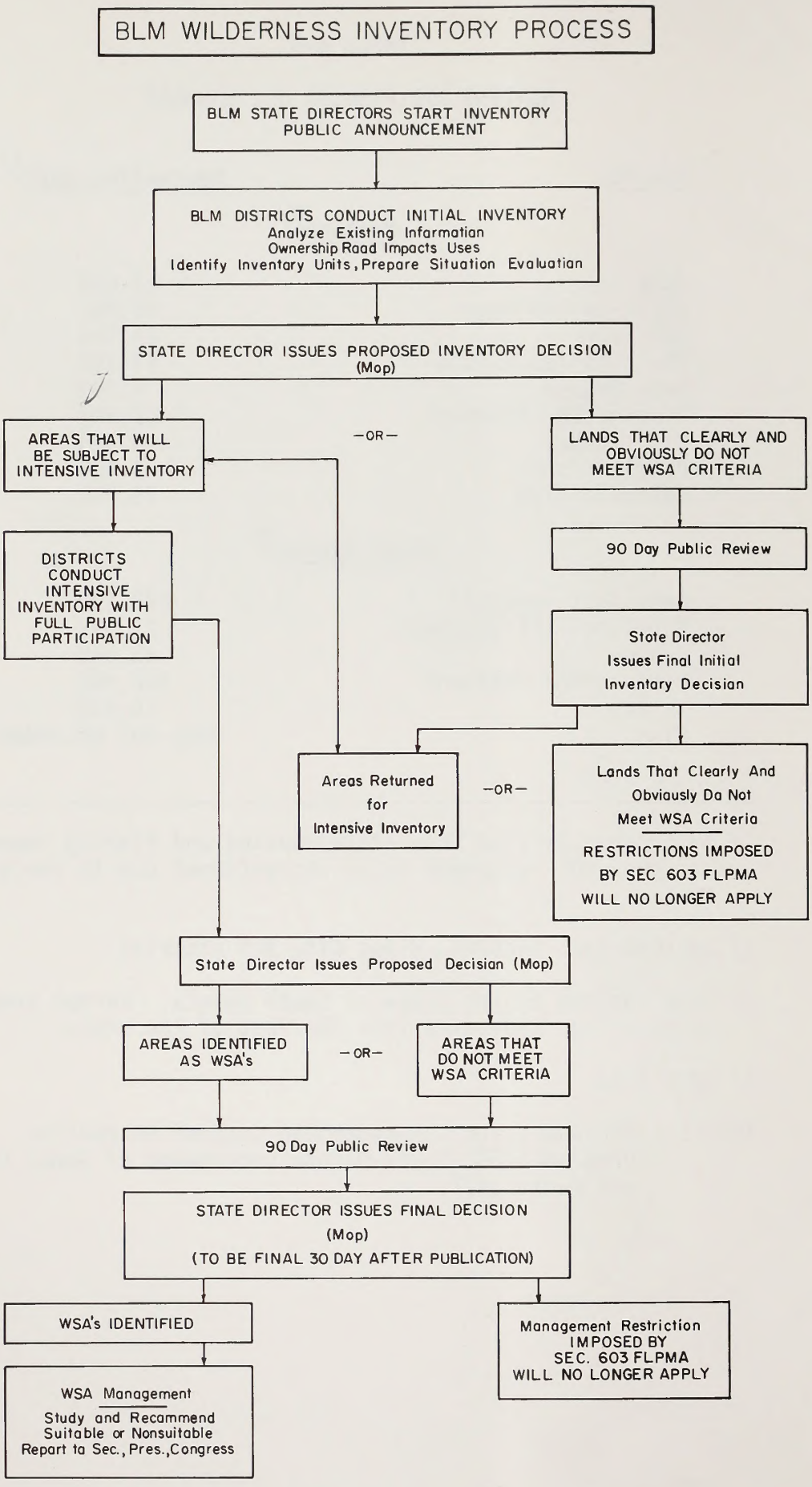
2/ Southeastern Montana, Miles City BLM District.

3/ Data for the entire state of South Dakota. Format precluded segregating study area from the rest of the state.

4/ 1977 data.

SOURCE: Montana State Comprehension Outdoor Recreation Program 1977; South Dakota Department of Game, Fish, and Parks 1977.

FIGURE 4—25



SOURCE: BLM WILDERNESS REVIEW HANDBOOK, 1979

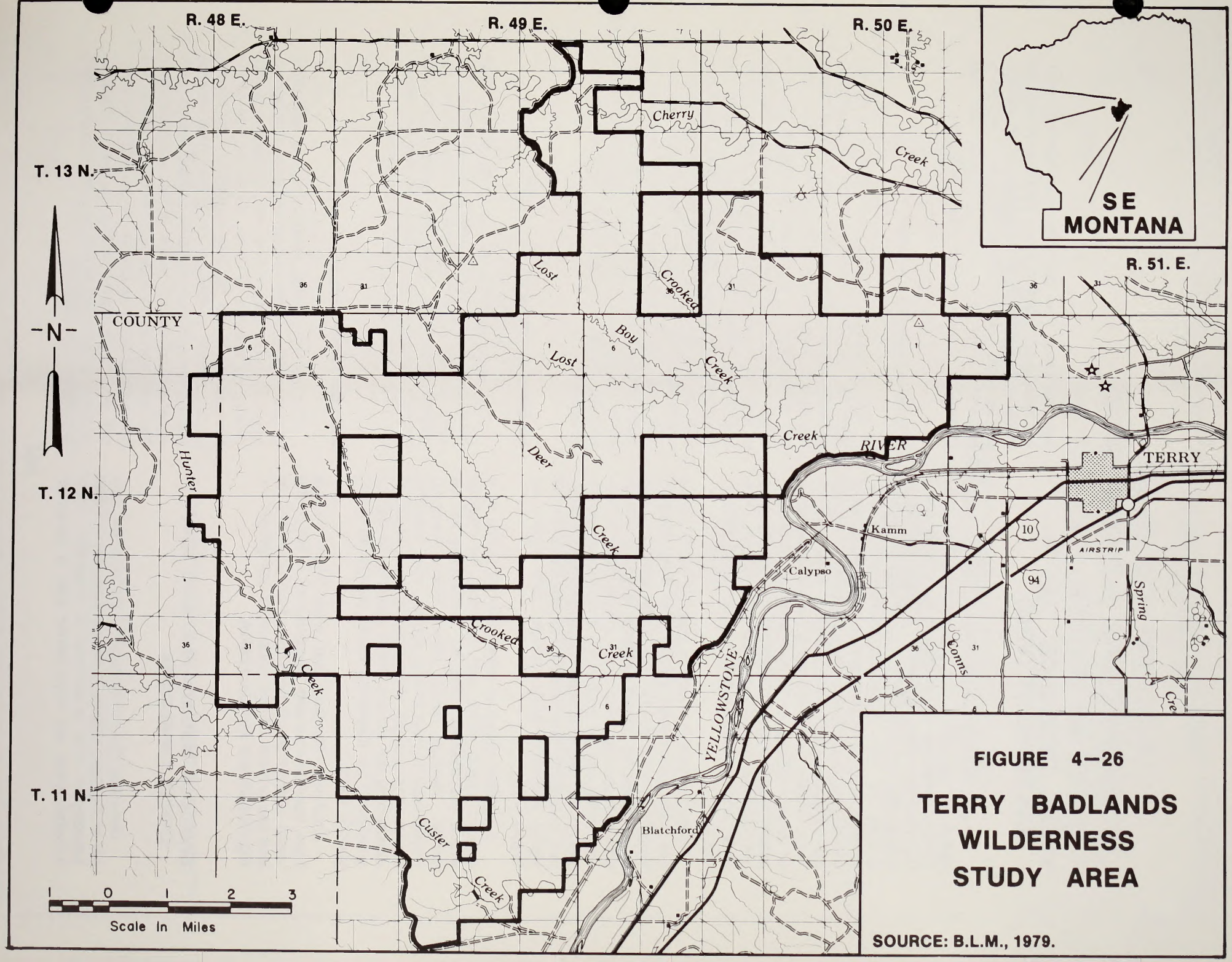


FIGURE 4—26

TERRY BADLANDS WILDERNESS STUDY AREA

SOURCE: B.L.M., 1979.

VISUAL RESOURCE MANAGEMENT (VRM)

If an object, activity or use cannot be seen, beauty or ugliness is not determinable. The VRM system measures visual change as visibility using the contrast rating system. The more a change differs, that is "contrasts," visually with the setting it is in, the more visible that change will be. The amount of visual change that is to be accepted is determined through the planning system through the assignment of VRM classes I, II, III, and IV. These VRM classes provide a numerical objective or target that represents that level of visibility an activity should meet as measured numerically using the "contrast rating." Within the VRM system, "visibility" and "contrast rating" can be used synonymously.

The acceptable level of visibility (VRM class) has been determined through the BLM planning system (manual 8411). This determination serves as a criteria for impact analysis. A visual change that exceeds the VRM class criteria using a contrast rating can be considered a significant impact, though the nature of that impact, positive or negative, cannot be determined. VRM objectives for the Visual Resource (VRM classes) are shown on Figure 4-27.

A contrast rating is specific to an action in a specific setting. Areas can, however, be mapped where the contrast rating for that activity will be similar. Variation within these areas, however, would result in more or less contrast and, thus, this approach to analysis, while establishing a means of determining the general visual impacts, cannot be substituted for measuring visual change on a site specific basis.

Southeast Montana and west South Dakota have been divided into "landscapes" in which the visual change would be similar for the various oil and gas actions. These landscapes are defined on Figure 4-28 and described below.

Southeast Montana and West South Dakota Landscapes

Generally, the landscapes of the area are typical of the prairie states including vast areas of little topographic relief or variation in vegetation. Most forested areas are more dense than a savannah but less dense than the softwood forests of western Montana. In prairie areas agricultural use, primarily dryland farming, is superimposed on the natural landscape. Most unfarmed areas are grazed by livestock. Urban and suburban development has generally focused on major creeks and rivers.

Prairie/Grassland Landscape

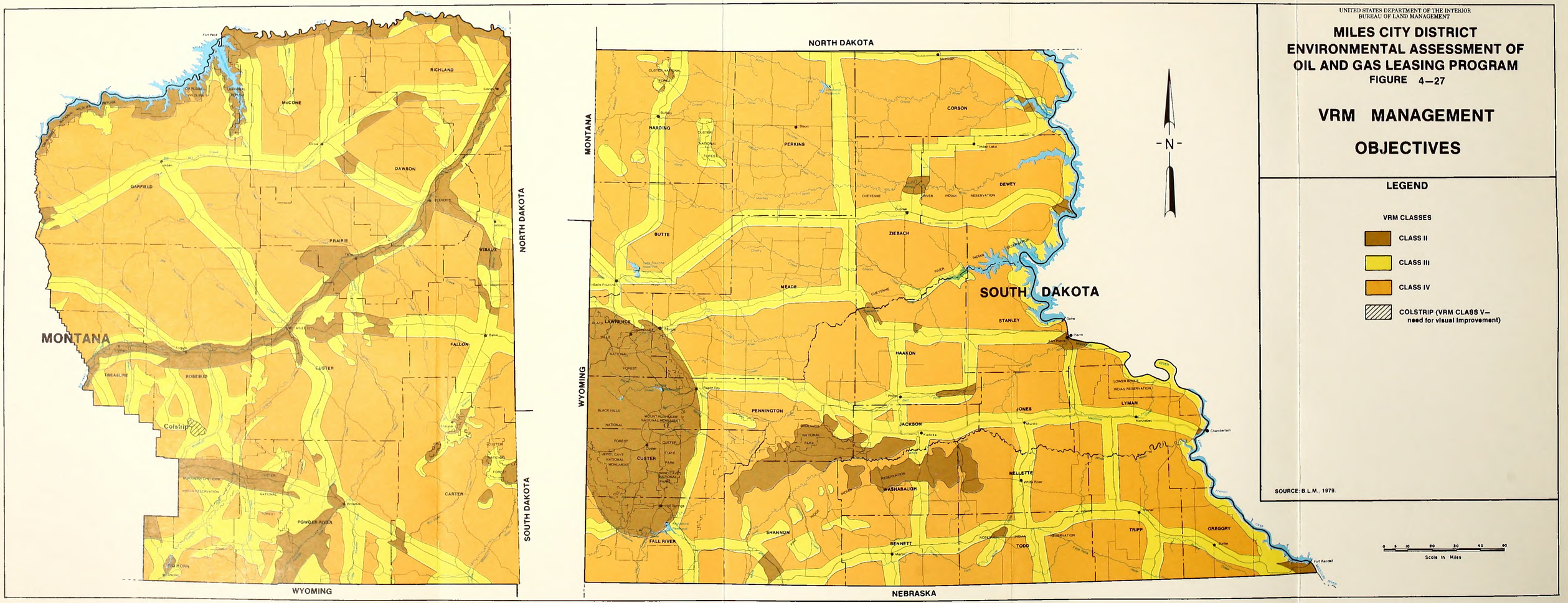
This landscape is horizontally aspected varying from flat to rolling with low forms of vegetation, primarily grass. Vertical features are not common in the natural landscape. Vegetation varies from virtually all grasses to grass and sagebrush. From a visual standpoint, these areas are similar because of their height and ability to absorb surface disruption. Those vertical features that do occur in this landscape, discussed elsewhere, gain importance with the prairie/grassland landscape as a setting. A common looking hill can become a prominent feature when set in an area with miles of prairie on all sides because of the attention it commands due to its verticality. This affect also applies to trees in wooded draws and man-made vertically oriented structures.

Scabland Landscape

Two areas in Montana, one to the northwest of Forsyth and one in the southeast corner of the state, are flat to gently undulating areas where sagebrush dominates. Soils are typically bentonite "gumbo" and resist the invasion of grasses. Disruption of the existing vegetation is long-lived.

Riparian Landscape

The natural riparian areas include a wide array of land uses described elsewhere, including agriculture and urbanization. The natural riparian areas, defined by low hills or bluffs on either side of the river or creek, are densely vegetated with copses of cottonwood and willow along the water courses surrounded with lush meadow grasses. Some riparian areas include only willow growth near the water. Tall tree growth provides opportunity to screen and camouflage activities but the trees also draw interest when in a prairie setting so that removal of portions of the trees would be very obvious unless accomplished sensitively.



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FIGURE 4—27

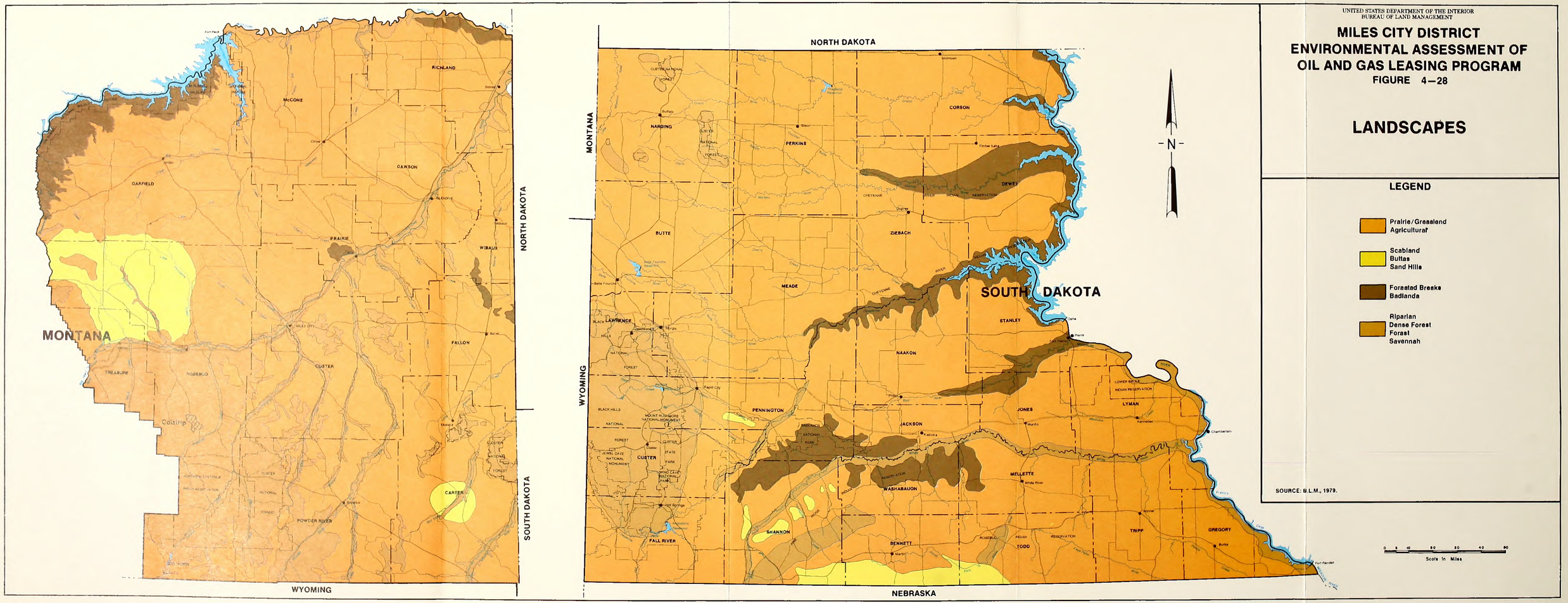
VRM MANAGEMENT OBJECTIVES

LEGEND

VRM CLASSES

- CLASS II
- CLASS III
- CLASS IV
- COLSTRIP (VRM CLASS V— need for visual improvement)

SOURCE: B.L.M., 1979.



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FIGURE 4—28

LANDSCAPES

LEGEND

- Prairie/Grassland Agricultural
- Scabland Buttes Sand Hills
- Forested Breaks Badlands
- Riparian Dense Forest Forest Savannah

SOURCE: B.L.M., 1979.

Scale in Miles

Wooded Draws Landscape

These areas are not shown on the map because of the scale of the areas. Many intermittent drainages are marked by dense tree growth of the same character described in the riparian landscape. The main differences in appearance are the lack of running water and the scale of the areas.

Dense Forest Landscape

This landscape includes scattered dense stands of ponderosa pine in Montana and the Black Hills of South Dakota. Topographically, these areas are hilly to mountainous with "V" shaped valleys and rounded to slightly flattened peaks. Some areas are marked by scattered boulders and rock outcrops, but most areas are densely wooded with timber. These areas appear uniform and are sensitive visually to indiscriminate clearing but restore themselves rather quickly.

Forest Landscape

These areas generally have more gentle relief than the dense forest landscape. Trees are in scattered stands and open stands with little undergrowth set in areas of prairie grassland. The trees are primarily ponderosa pine but in at least one area, dominated by juniper. Rock outcrops are common in these areas. In general, the forest landscape can be considered trees with prairie. These areas have the capacity to absorb a considerable amount of use without significant visual effect because the openings created by human activity can be planned to be indistinguishable from natural openings and trees are dense enough to hide human activity.

Savannah Landscape

Where the forest landscape is "trees with prairie," the savannah landscape is "prairie with trees." The topography is similar to the forest landscape. Vegetation is generally grassland with sagebrush in some areas marked by clumps of ponderosa pine or solitary trees. This landscape has the potential to absorb a considerable amount of disturbance without apparent visual affect. The trees are not generally dense enough to hide all activity and the natural distribution of trees is difficult to replicate; therefore, restoration of the natural visual character of this landscape may present some problems if care is not taken during the implementation of an activity.

Agriculture Landscape

Agriculture in the area includes dryland farming, irrigated farming, and pasture areas in all other landscapes. The most intensive farming areas are indicated on the map, but scattered farms may be found throughout the area. The character of agricultural lands is constantly changing, from season to season and year to year. The influence of agricultural use tends to dominate the natural prairie/grassland landscape where the two are interspersed because of the regularity of square or rectangular lines which attract the attention of an observer. Constant change in this landscape implies that efforts to visually blend activities with this landscape would be futile.

Urban/Suburban Landscape

Towns and villages can be found in all landscapes but are particularly common in riparian areas. Generally, these concentrations of populations are oriented toward agricultural activity and support of farming, but occasionally include some light industry. This landscape is in a state of flux and may change character over time.

Badlands Landscape

Badlands are areas with sometimes dramatic erosional features and sparce vegetation. The vegetation that is present concentrates in drainages, swales, and on north-facing slopes. Badlands formations themselves are vertical and nearly vertical clay bluffs and butte-like formations that are severely gullied and banded with strata of different often analogous colors. The badlands of South Dakota are definitive with bands of greys, reds, and browns. Other badlands are chiefly grey with muted tones of browns or reds.

The arrangement of the bands of color and vertical orientation of the formation make restoration of the badlands to a natural appearing state virtually impossible. Over a long period of time, natural erosion could restore the badlands appearance by accelerating erosion and using unconventional rehabilitation techniques to increase rather than decrease erosion.

Breaks Landscape

This landscape is similar to the badlands landscape except that more vegetation is present and erosion is not quite as severe. The breaks are composed of irregularly dissected areas of "broken ground" cut into the surrounding plateau by water

erosion. Vegetation is similar to the surrounding prairie but includes areas of virtually bare ground.

Forested Breaks Landscape

Forested breaks are similar to the breaks except that the north slopes are forested with ponderosa pine and/or juniper.

The topographic complexity of the breaks landscape makes access to an activity site difficult and while this same complexity increases the ability to hide an activity behind landforms, the steep slopes make extensive damage inevitable.

Buttes Landscape

This landscape, not fully shown on the map, includes landforms thought of as pinnacles or buttes and also solitary hills. These vertical features gain importance they would not ordinarily command because they are significant as landmarks and provide relief from monotony. The most important characteristic is verticality. Changes on or near these features are more likely to be noticed because the feature itself attracts attention.

The maps depicting the landscapes described are general. On a site-specific basis, any "landscape" can and probably will be found within the area mapped as another landscape type. Landscapes such as buttes, wooded draws, and riparian may be found throughout the area and the majority of these areas are not depicted on the maps.

CULTURAL RESOURCES

Prehistoric Features

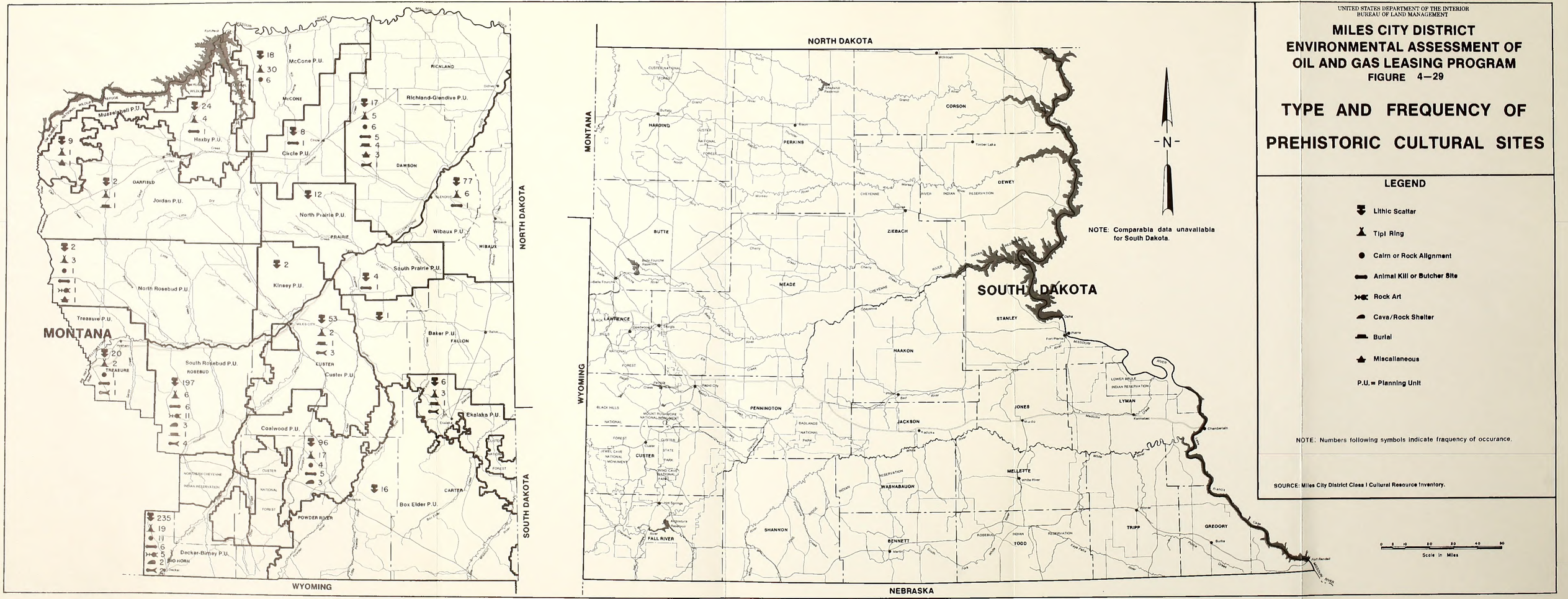
Evidence exists for man's prehistoric occupation of most of the study area through all of the known range of prehistory, although the evidence is scattered and site density is variable. The Miles City District files summarize the number and types of sites assignable to each prehistoric culture period. However, because the artifacts identified or collected from the surface often are not sufficient proof of culture period association, many sites cannot be identified as to culture period affiliation. If these sites were excavated to recover subsurface material, many would definitely be tied to one of three culture periods discussed below.

The known range of prehistory includes three general culture periods, Early Prehistoric (13,000 - 5500 B.C.), Middle Prehistoric (5500 B.C. - A.D. 200), and Late Prehistoric (A.D. 200 - A.D. 1800). During all three periods, the way of life on the Northwestern Plains was oriented toward some kind of hunting of game and collecting of wild plant foods. As such, the groups of people were quite small, had no permanent settlements, and therefore possessed only a limited toolkit composed principally of stone, wood, and bone objects (at least those objects likely to be preserved in an archaeological site are of these materials). Because of these factors, most prehistoric sites in the plains are small and contain only limited numbers of artifacts and faunal or vegetable materials used as food. Extending this reasoning, older sites are more likely to have been destroyed by erosion and other factors of time, making sites from the Early Prehistoric Period the most rare and sites from the later periods the most common.

On the eastern fringe of the South Dakota portion of the study area, there may be prehistoric sites which relate to the Middle Missouri cultural subarea. The way of life in this region along the Missouri River was similar to that described above during the Early Period and Early Middle Period. However, from 500 B.C. through the Late Prehistoric Period, a sedentary horticultural lifestyle developed. There are substantial earthlodge villages and burial mounds, primarily within the Missouri trench. Since villagers here grew crops and were relatively sedentary, their toolkits included many implements for horticulture and pottery. Occasionally, sites related to this cultural subarea may be found some distance west of the Missouri River, even into eastern Montana. However, these sites are probably few and those which are not earthlodge villages may be indistinguishable from Northwestern Plains Late Period sites, unless pottery is present.

The hunting and gathering way of life, which dominated the region, limits the types of prehistoric sites that can occur. Approximately 1,000 prehistoric sites have been documented in the Montana portion of the study area. Figure 4-29 shows the major types of sites present on the Northern Plains and the frequency of their occurrence within the Montana Planning Units of the study area as evidenced by the present amount of archaeological inventory. Lithic scatters, which are the stone debris and stone tools left behind when tools are made or used, and tipi rings, which are circular stone features usually 4 to 8 meters in diameter and assumed to have been anchor stones for the conical skin tent or tipi of prehistoric peoples, make up the most common site types. Other site types are more rare. Rock cairns and rock alignments are often associated with animal kill sites and were features used to channel herd animals towards a kill site. It is difficult to determine the exact function of rock cairns when they stand alone and are not associated with other site types. Rock art refers to paintings or carvings done on rock by prehistoric people. Rock shelters are shown in Figure 4-29 as a separate site type because types of artifacts and features made of perishable material are often preserved in this protected environment, but not in open sites. The burial site category burial refers to human burials. Sites containing pottery are listed separately because they may be related to Woodland or Middle Missouri culture. Some site types are not represented in all planning units. Because only a small percentage of the study area has thus far been inventoried, a small number of each of the more rare site types will probably be found in the future.

The sampling-type inventories conducted for BLM planning purposes have covered less than one percent of the study area. As outlined in Table 4-7, these surveys have been completed in 3 of 26 planning units. These inventories were in areas of relatively low site density and that, combined with the low percentage of coverage, produced archaeological predictions of limited usefulness. The statistics derived from the inventories include site density per 640 acres, the expected number of sites in each planning unit, and range of site numbers in each planning unit. Because of the wide margin of error and low number of sites found, this level of



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FIGURE 4—29

TYPE AND FREQUENCY OF PREHISTORIC CULTURAL SITES

LEGEND

- Lithic Scatter
- Tipi Ring
- Cairn or Rock Alignment
- Animal Kill or Butcher Site
- Rock Art
- Cave/Rock Shelter
- Burial
- Miscellaneous

P.U. = Planning Unit

NOTE: Numbers following symbols indicate fraquency of occurance.

TABLE 4-7

SAMPLING-TYPE INVENTORIES FOR PREHISTORIC CULTURAL RESOURCES
(CURRENT STATUS)

Planning Unit	Acres in P.U. From Which Sample Was Drawn	Percentage of Area Inventoried	Number of Sites Found	Density - Site Per 640 Acres	Expected Number of Sites in P.U.	Range of Site Numbers if P.U. at 90% Confidence Interval
Musselshell	150,400	6.5	7	.46	108	29-137
Haxby	243,840	4.9	27	1.37	522	289-755
McCone	156,800	5.5	43	3.73	914	373-1455

SOURCE: Miles City District Class I Cultural Resources Inventory.

accuracy in prediction precluded development of other useful information such as correlation between environment and site numbers and types, even the accurate prediction of number of sites in each site type per planning unit. For further detail, see Canan 1977.

A fourth sampling survey has been initiated in the Wibaux Planning Unit where preliminary analysis indicates a higher site density than previously recorded. There may be an average of five to six sites per 640 acres in this unit. However, accurate statistics cannot be calculated until the inventory is complete.

While no reliable sampling survey has been done in Big Horn and Powder River Counties, about 50,000 acres were inventoried at various levels of intensity. Most of the work was sponsored by the coal industry in compliance with mineral leasing regulations. Here the site density varies from less than one site to greater than six sites per 640 acres, averaging three sites per 640 acres. These figures are not statistically reliable, however. Since the sampling-type surveys have been conducted on public lands, our understanding of site densities applies only to federally-owned surface. It is not known if private lands will yield statistics similar to current BLM inventory information.

The surveys have documented prehistoric features of varying significance. Significance is generally measured by how much information the sites can contribute to the knowledge of what form prehistoric life took in the area and what caused that pattern to change through time. Another factor in establishing site significance is the potential the feature may have for public enjoyment and education. Most of the 1,000 sites recorded in the study area have not been investigated thoroughly enough to establish their relative significance. The scarce site types, such as animal kill and butchering sites, burials, rock shelters, pottery sites, and some lithic scatters are more easily considered to be highly significant because of their obvious potential to yield cultural information. Although the majority of lithic scatters and tipi rings are more common, they too may contain information important to interpreting prehistory. Proper evaluation of most of these sites can be made only after they are better understood through testing for the existence of subsurface cultural deposits and improved archaeological methods. None of the prehistoric properties recorded have been completely studied for their public enjoyment and education potential.

These prehistoric sites were recorded in surveys conducted by archaeologists working for industry, surveys sponsored by BLM for input to its planning process, and surveys conducted prior to approval of BLM initiated projects. Other inventories were done in response to federal highway construction and State of Montana projects. A few sites have been recorded by laymen interested in cultural resources. Details of all the surveys conducted and sites recorded can be found in the Miles City District files. Data regarding sites recorded in South Dakota under BLM jurisdiction are not yet compiled.

Historic Features

Historic sites can be important for their potential to add depth to the historic record and for interpretation and public enjoyment. Some of the sites may also be significant to cultural studies in the same way as prehistoric sites.

Approximately 34 historic sites are recorded for the study area (Table 4-8). Many more are thought to exist as indicated in the historical summary for the district. Known sites on public land have been recorded in BLM sampling inventories, BLM planning efforts, and surveys by the State of Montana. The inventory to date is not representative of every phase of the study area's historical development.

Historic development began with the advent of white men onto the Northwest Plains. In the 18th Century, the French traders, such as LaVerendrye, were the first to make contact with the Middle Missouri and Plains Indians tribes. Fur trade initiated by the French Canadians was subsequently developed by free traders and representatives of the British Hudson's Bay Company. Increased French and British influence in the region prompted Americans to launch the Lewis and Clark Expedition in 1804.

Ascending the Missouri River in 1805, the Lewis and Clark party camped at several locations on the north border of the study area. Captain Lewis' contingent passed through the same area on the return trip in August, 1806. The Lower Yellowstone River Valley was the scene of a few campsites related to Clark's 1806 return voyage. It is doubtful that these camps can be located with accuracy due to natural shifting of most river channels.

Organized fur traders followed the Lewis and Clark Expedition to the Yellowstone and Upper Missouri country. Most of the activity associated with the trade in the study area was confined to a narrow corridor along the two major rivers between 1820 and 1860. Trading posts or forts in the study area were constructed on the Yellowstone River. While the locations of most of the posts are only vaguely known, future surveys may locate cultural resources related to the sites. It is probable that these locations are now in private ownership.

Except for a brief reconnaissance by General Henry Atkinson in 1825, official exploration and

TABLE 4-8

STUDY AREA HISTORIC FEATURES

Type	Number Recorded as of August 1978
Homestead	17
Sod House	1
Military Campsite	2
Railroad Construction Camp	1
Military Fort	1
Military Battle Site	8
Trash Scatters	4
TOTAL	34

SOURCE: Miles City District Class I Cultural Resource Inventory

mapping of the Yellowstone and Upper Missouri was not attempted until 1859-1860. Captain W. F. Raynolds led a party of surveyors across much of the study area during this period.

Before Raynolds journeyed through the area, the Teton Sioux were forcing their way into the Yellowstone Country. Feeling pressure from white expansion to the east, the Sioux moved into much of the western Dakotas, northeastern Wyoming, and southeastern Montana. They had become the most powerful of Plains tribes, rich in horses and white trade goods. With little difficulty, they took over former Crow Territory along the Lower Yellowstone. Their hunting and raiding extended as far north as the Missouri and west to the Musselshell and beyond.

Incursions by whites into Indian lands and Indian depredations on the white precipitated the final conflict between the Sioux and U.S. Government in the 1870s. The Yellowstone River and its tributaries were the setting for most of the confrontations; the Reynold's Battle on Powder River, the Battle of the Rosebud, Battle of the Butte on Tongue River, and many smaller engagements within the study area. Custer's Battle of the Little Big Horn lies just to the west of the study area.

Following the summer campaign of 1876, Fort Keogh (Tongue River Cantonment) was established at the mouth of the Tongue River. Here, Col. Nelson Miles' Fifth Infantry operated a sustained campaign to destroy Indian villages and material in the winter. Many of the Indian war engagements between 1876 and 1881 were in the study area and several are significant cultural sites (Table 2-7).

The hostile Sioux took refuge in Canada and by 1878 whites began to enter the Lower Yellowstone and Upper Missouri in greater numbers. Working out of the settlement of Miles City, many of the new residents became active in bison hide hunting. The study area was the scene of the slaughter of the last great buffalo herd. Existing inventories have not found sites related to this period, but buffalo hunter dugouts or cabin remains probably exist.

The bison were all but annihilated by 1884 and the plains were covered with thousands of tons of bones. Even these were not evident by 1901 as Indians, Red River half-breeds, and whites picked them up and sold them to eastern companies that ground the old bones for sale as fertilizer while the fresh bones were used to make a calcium phosphate neutralizer for sugar refining.

Even before the bison were nearly exterminated in 1883, cattlemen were stocking the ranges. By 1881, the open range era was in full swing as cattle were driven into Montana via the Texas (Northern) Trail which crossed from south to north in the Miles City District, terminating in the Big Dry Country.

After the disastrous winter of 1886-87, cattle operations declined, centering around the more watered valleys where hay could be raised to provide supplemental feed in the winter. Most of the ranch headquarters of this era were located in the most attractive areas for ranching, and today are private land holdings. Major features located on public land are likely to be more ephermeral things, such as corrals, sheepsheds, line camps, and sheepherders stone piles. Similar to the overland freight trails of the steamboat era, these features are not well documented, and are more likely to be discovered by systematic ground inventory than by record searches.

The Northern Pacific Railroad pushed west from Bismarck, North Dakota, reaching Miles City in 1881 to provide much needed transportation for commercial development. Settlement from 1881 to 1900 was slow, but changes in the Homestead Act and railroad promotion helped create a major influx of people into the study area. With the promise of dry farming techniques, many people took up 160, 320 or 640 acre homesteads in the study area between 1910 and 1925.

The period from 1930 to the present has been a period of slow adjustment to the realities of a harsh, semi-arid environment. Much of the land in the study area is in federal or state ownership; most continuing patterns of land use are in some degree dependent on governmental actions and policy. BLM jurisdiction over the area came about in 1946 when the Grazing Service and General Land Office merged into one agency. However, many man-made features, some of which may become objects of historical importance, began to appear on federal lands as a result of the 1934 Taylor Grazing Act and the creation of the Grazing Service. The Taylor Act included creation of grazing district and withdrawal of included lands from homestead entry. This, in turn, allowed the expenditure of public funds for conservation and management purposes. The first major features from this expenditure of funds were produced by the Civilian Conservation Corps of the 1930's. This organization built reservoirs, fences, and trails.

Nineteenth century mineral development in the study area was limited to the gold rush of the Black Hills of South Dakota. Development of fossil fuels began in the 1920's with the Cat Creek Oil Field and the original NP Railroad coal strip mine at Colstrip, Montana. After 1952, oil was developed in other portions of the study area (see Chapter 4, Geology and Land Use). Today, the development of fossil fuels in the study area is becoming a focal point of the region's commercial growth. It will no doubt figure prominently in the late 20th Century history of the area.

ECONOMIC AND SOCIAL CONDITIONS

The nature of the study area is predominately rural in both Montana and South Dakota; a significant portion of the area's social and economic activity revolves around agriculture. Economic activities and social attitudes/values in the area have changed very slowly in the past, although recent energy development (e.g., coal, oil, gas) has accelerated the rate of both social and economic change.

Eastern Montana

Population

The total estimated population in the Montana portion of the Miles City District was 59,600 in 1975. This represents a 4.3% increase over the 1970 population of 57,137. Population forecasts through 1985 indicate that the total population in this twelve county portion of the study area will grow by 15% from 1975 to 1985 (Table 4-9). Custer, Dawson, and Richland Counties are expected to realize the greatest percentage increase in population because of the existing population and trade centers (Miles City, Glendive, Sidney, respectively) located in those counties.

Employment

Total employment levels increased by roughly 13% from 1971 to 1976 (Table 4-10). Rosebud County experienced the greatest percentage increase in employment (52%) during this period primarily as a result of coal fired power plant construction at Colstrip, Montana. Available employment figures for this portion of the study area show that there are a significant number of oil and gas workers directly involved with oil and gas activity (Table 4-11). These figures include well servicing and other directly related activities which are dependent upon oil and gas exploration and production. In addition, Table 4-11 shows the estimated indirect employment generated by expenditure of direct oil and gas employment payrolls. As such, these numbers give an indication of the total employment associated with oil and gas activity in this portion of the study area. The 633 direct employees shown in Table 4-11 represent 2.2% of the total 1976 employment (28,324), while the total (direct and indirect) oil and gas related employment level of 1,209 represents approximately 4.3% of total 1976 employment. Direct county by county oil and gas employment as a percent of total employment is shown in Table 4-12. Fallon County has the highest percentage of oil and gas employees in the study area primarily due to the Cedar Creek and other oil/gas fields in that county.

Personal Income

Total personal income in the Montana portion of the study area increased by 85% from 1971 to 1976 (Table 4-13). It should be noted that a large part of the increase in personal income in all counties in the study area from 1971 to 1973 was directly due to high agricultural sector earnings. In 1973 and 1974, high agricultural output and high prices combined to increase agricultural sector income to many times the 1971 level. Similarly, the very high contract construction sector growth in Rosebud County for Colstrip 1 and 2 during 1974 and 1975 is reflected in the overall income growth for that county.

Due to the lack of reliable oil/gas field income data, it is necessary to estimate the average oil/gas workers' income in order to calculate the contribution of this activity to county income totals.

Assuming that the average oil/gas related worker earned approximately $18,000 per year in 1976, it is possible to estimate the percentage contribution of oil/gas related incomes to total county income (Table 4-14). Indirect income generated by direct oil and gas income expenditure can be estimated by using a region-specific oil and gas income multiplier of 1.560. Table 4-15 indicates that total oil and gas related income (direct and indirect) exceeded 20% of the county total in the case of Fallon and Powder River Counties, which contan the large Cedar Creek and Bell Creek fields, respectively.

Public Finance

The counties in the study area all depend heavily upon property taxes for their main revenue source; 60% dependence on this revenue source is the average in the study area. There is a relatively low per capita taxable valuation (compared to the rest of the state) which may strain the financing of

TABLE 4-9

POPULATION ESTIMATES

County/ Community	1975	1980	1985	% Change 1975-1985
Carter	1,900	1,853	1,882	- 0.9
Ekalaka	657	640	651	- 0.9
Custer	12,000	13,524	14,642	+22.0
Miles City	9,478	9,712	10,235	+ 8.0
Dawson	10,700	11,881	13,067	+22.1
Glendive	6,691	6,755	7,231	+ 8.1
Richey	406	410	439	- 8.1
Fallon	4,000	4,048	4,326	+ 8.2
Baker	2,564	2,595	2,773	+ 8.2
Garfield	1,700	1,689	1,784	+ 4.9
Jordan	542	539	568	+ 4.8
McCone	2,700	2,530	2,613	- 3.2
Circle	1,112	1,042	1,075	- 3.3
Powder River	2,400	2,203	2,285	- 4.8
Broadus	863	792	822	- 4.8
Prairie	1,900	1,895	1,915	+ 0.8
Terry	988	986	996	+ 0.8
Richland	9,900	11,186	12,093	+22.2
Fairview	1,047	1,075	1,131	+ 8.0
Sidney	4,637	4,764	5,013	+ 8.1
Rosebud	9,700	10,870	11,230	+15.8
Forsyth	2,811	2,864	2,880	+ 2.5
Treasure	1,200	1,199	1,236	+ 3.0
Hysham	617	616	636	+ 3.1
Wibaux	1,500	1,474	1,538	+ 2.5
Wibaux	667	656	684	+ 2.5
12-County Total	59,600	64,352	68,611	+15.1

SOURCE: Montana Population Projections 1975-2000 (medium growth scenario), Division of Research and Information Systems, Helena, Montana 1977.

TABLE 4-10

TOTAL EMPLOYMENT IN STUDY AREA[1/]

County	1971	1973	1975	1976	% Change 1971-1976
Carter	902	841	803	794	-12.0
Custer	5,376	5,433	5,930	5,911	10.0
Dawson	4,954	5,315	5,216	5,370	8.4
Fallon	1,680	1,652	1,806	1,852	10.2
Garfield	868	843	805	774	-10.8
McCone	1,410	1,452	1,494	1,493	5.9
Powder River	1,204	1,142	1,142	1,136	- 5.6
Prairie	826	868	900	925	12.0
Richland	4,124	4,315	4,594	4,785	16.0
Rosebud	2,761	3,174	4,858	4,188	51.7
Treasure	477	491	483	462	- 3.1
Wibaux	581	598	601	634	9.1
12-County Total	25,163	26,124	28,632	28,324	12.6

1/ Includes full and part time wage and salary employment plus proprietorships.

SOURCE: Regional Economic Information System, Bureau of Economic Analysis, U.S. Department of Commerce 1979.

TABLE 4-11

ESTIMATED 1976 OIL AND GAS EMPLOYMENT BY COUNTY[1/]

County	Estimated Total (Direct & Indirect) Oil and Gas Employment	Direct Employment[2/]	Indirect Employment[3/]
Dawson	296	155	141
Fallon	309	162	147
Powder River	155	81	74
Richland	334	175	159
Rosebud	115	60	55
TOTAL	1,209	633	576

1/ Includes extractive and service workers. In some cases, figures on employment were interpolated from employment ranges.

2/ Direct employment includes all workers which are directly involved with oil and gas field activities. This includes those workers employed on drill rigs as well as ancillary workers such as mud pumpers, well servicemen, etc.

3/ A regional oil and gas employment multiplier of 1.909 was used to estimate indirect employment. (Source: Lower Yellowstone Social and Economic Analysis, Centaur Management Consultants 1978.)

SOURCE: County Business Patterns - Montana 1976, U.S. Department of Commerce. Total employment figure for Powder River County is from Lower Yellowstone Social and Economic Analysis, Centaur Management Consultants 1978.

TABLE 4-12

ESTIMATED 1976 DIRECT OIL AND GAS EMPLOYMENT
AS A PERCENT OF TOTAL COUNTY EMPLOYMENT

County	Direct Oil and Gas Employment	Percent of County Total
Dawson	155	2.9
Fallon	162	8.7
Powder River	81	7.1
Richland	175	3.7
Rosebud	60	1.4
TOTAL	633	

SOURCE: Derived from Tables 4-10 and 4-11.

TABLE 4-13

TOTAL PERSONAL INCOME BY COUNTY
($000)

County	1971	1973	1975	1976	% Change 1971-1976
Carter	5,414	12,478	5,534	8,309	53.5
Custer	45,655	60,553	68,203	72,153	58.0
Dawson	33,921	61,611	57,890	63,363	86.8
Fallon	9,967	19,394	17,381	19,658	97.2
Garfield	6,312	13,949	11,647	9,582	51.8
McCone	8,880	31,683	18,237	22,077	148.6
Powder River	7,694	14,798	9,705	10,587	37.6
Prairie	4,973	13,588	10,318	12,324	147.8
Richland	28,893	47,009	54,467	50,378	74.4
Rosebud	17,208	30,875	49,795	46,614	170.9
Treasure	4,744	6,871	5,565	5,316	12.1
Wibaux	3,122	8,754	6,136	6,445	106.4
12-County Total	176,783	321,563	314,878	326,806	84.9

SOURCE: Regional Economic Information System, Bureau of Economic Analysis, U.S. Department of Commerce 1979.

TABLE 4-14

SIGNIFICANCE OF DIRECT OIL/GAS INCOME TO TOTAL PERSONAL INCOME
($000)

County	Estimated Direct Oil/Gas Personal Income[1/]	1976 Total Personal Income	Direct Oil/Gas Income As % of Total County Personal Income
Dawson	2,790	63,363	4.4
Fallon	2,916	19,658	14.8
Powder River	1,458	10,587	13.8
Richland	3,150	50,378	6.3
Rosebud	1,080	46,614	3.3

1/ Assuming $18,000 annual income per worker. Direct 1976 oil and gas employment levels from Table 4-12.

SOURCE: Derived from preceding tables.

TABLE 4-15

CONTRIBUTION OF TOTAL OIL/GAS INCOME TO COUNTY TOTAL - 1976

County	Total Oil/Gas Income (Direct and Indirect) ($000)	Total Oil/Gas Income As % Of Total County Income
Dawson	4,352	6.9
Fallon	4,549	23.1
Powder River	2,274	21.5
Richland	4,914	9.8
Rosebud	1,685	3.6

1/ Assumes an oil and gas income multiplier of 1.560 (i.e., the "direct" personal income values in Table 4-14 are multiplied by 1.560 to determine the total (direct and indirect) income dependence upon oil and gas activities).

SOURCE: Derived from Table 4-14.

TABLE 4-15

CONTRIBUTION OF TOTAL OIL/GAS INCOME TO COUNTY TOTAL - 1976

County	Total Oil/Gas Income (Direct & Indirect) ($000)	Total Oil/Gas Income As % Of Total County Income 1/
Dawson	4,352	6.9
Fallon	4,549	23.1
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Richland	4,914	9.8
Rosebud	1,685	3.6

1/ Assumes an oil and gas income multiplier of 1.560 (i.e., the "direct" personal income values in Table 4-14 are multiplied by 1.560 to determine the total /direct and indirect/ income dependence upon oil and gas activities)

SOURCE: Derived from Table 4-14

public service improvements. This would certainly occur if heavy demands develop on municipal services as a result of population growth due to energy projects since municipalities cannot tax projects (e.g., refineries, gas treatment plants, etc.) which are built outside the city limits. Additionally, most communities are already at or near the 65 mill tax limit placed on property tax assessment.

Many of the towns in the study area receive intergovernmental transfers of funds, primarily from the federal government in the form of revenue sharing funds. During FY 1978, 34% of all municipal revenues in the study area came from these intergovernmental transfers. It is very likely that most communities would have to depend upon these revenue sources even more if faced with a dramatic population increase in the future. The community of Forsyth in Rosebud County is an example where 83% of its total revenues in FY 1978 came from intergovernmental transfers, primarily from the federal government. This is in response to the large energy related population growth at Colstrip, Montana.

Infrastructure

For the most part, the 20 communities in the study area with municipal water systems have adequate capacity to meet current needs and would be able to accommodate some increase in population (Table 4-16). Fairview and Golva both require additional wells as do Wibaux and Broadus. Baker's water system is also currently at capacity.

Twenty-three of the communities in the study area have sewage treatment facilities. However, only Ekalaka has an actual treatment plant; the remaining 22 communities use lagoons (Table 4-17). Both Forsyth and Miles City have significant odor problems at times which would be eliminated with the construction of a new lagoon in each community. It is possible that several of the communities in the study area would experience sewage problems with their present sewage facilities if significant population growth occurs in the future. It is likely that future coal development or oil/gas development could provide the stimulus for this level of population growth.

There are two natural gas "service divisions" of the Montana Dakota Utilities in the study area; the Glendive Division and the Miles City Division (Table 4-18). Some areas within each division are experiencing difficulties in obtaining enough natural gas hookups to satisfy demand. The Glendive Division is currently allowing 231 hookups per year (2.3%) while the Miles City Division allows 105 hookups per year (2.0%).

Electric power in the study area is provided by the utilities listed in Table 4-19. The region is divided according to the type of generation and utilities supplier; this division is termed the "East West Separation." West of the Separation, the majority of the power is hydrogenerated, while east of the Separation, electric power is primarily supplied by coal fired generators. Montana Dakota Utilities and the Upper Missouri G&T Cooperative (supplied by the Bureau of Reclamation and Basin Electric Power Cooperative, Inc.) provide service east of the Separation. Montana Power and Central Montana G&T Cooperative (supplied by Montana Power and Bureau of Reclamation) serve the area west of the Separation. The coal-fired energy suppliers foresee no problems supplying electricity east of the Separation through 1987. West of the Separation (i.e., the area served primarily by hydroelectric power), problems are expected by 1982 if river flows are below normal and Colstrip 3 and 4 are not underway. This would occur if west of the Separation suppliers are forced to shuttle some of their coal fired power to the relatively hydro dependent counties in the western part of Montana. A severe 1982-83 winter would probably require temporary rolling blackouts (power shut off at substations for one hour or so a day), and the curtailment of service to some large industrial/commercial customers whose operations are not critical.

Health care in the study area is very unevenly distributed. In some areas, a surplus of health facilities exist; while in other areas, there are no facilities at all. The sparse population base and large distances involved mean that many people experience difficulties accessing the available health facilities.

The Montana Department of Health and Environmental Sciences has included Bighorn, Fallon, Rosebud, Treasure, and Wibaux Counties in health care districts designated as "Primary Medical Care Shortage Areas." This classification reflects a shortage of primary care physicians in these areas based upon 1976 population estimates.

Mental health and drug abuse centers are located in only eight communities in the study area. The personnel who staff these facilities set aside in the various hospitals reside in Miles City. They have to "ride the circuit" of 17 counties. In most cases, first line contact with someone having a stress induced psychological crisis is the county public health nurse or a hospital employee. If the appropriately trained professional is not scheduled to arrive under the normal routine, emergency response for crisis intervention may be to move the patient to a larger community, or to have the trained professional make up a special trip. This travel routine is, both in normal (scheduled trips) and emergency cases, quite wasteful of professional time. Drug abuse is

TABLE 4-16

MAJOR COMMUNITIES WITH PUBLIC WATER SUPPLY SYSTEMS AS OF MARCH, 1978

County	Community	Source	1978 Pumping Capacity (1,000 GPD)	1977 Average Utilization (1,000 GPD)	1978 Storage Capacity (1,000 gallons	Comments
Carter	Ekalaka	wells	302	114	35	No problems, no plans to expand.
Custer	Miles City	Yellowstone River and well	7,000	5,000	2,500	No problems, no plans to expand (a new water treatment facility became operational in 1976).
Dawson	Glendive	Yellowstone River	4,000	1,000	2,000	No significant problems, no plans to expand.
	Richey	wells	230	135	138	No problems, no plans to expand.
Fallon	Baker	wells	800	800	516	Although the system is operating at capacity, there are no plans to expand.
	Plevna	wells	202	Not Available	15	No problems, no plans to expand.
Garfield	Jordan	well	216	80	200	No problems, no plans to expand.
McCone	Circle	wells	576	117	340	No problems, no plans to expand.
Powder River	Belle Creek	wells	144	15	42	No problems, no plans to expand. At one time a population of 500 was adequately handled by this system. Currently about 130 people are served.
	Broadus	wells	986	356	100	Storage capacity inadequate. Application is to be made for funding in summer of 1978 to add storage facilities and an additional well.
Richland	Fairview	wells	360	360+	100	Problems due to mineral content of one well. Only one well is currently operational and the town is attempting to secure outside funding for a new well.
	Lambert	well	115	30	50	No problems, no plans to expand.
	Sidney	wells	3,816	988	1,310	No problems, no plans to expand.
Rosebud	Ashland	wells	180	100	200	No problems, system became operational in March, 1977.
	Colstrip	Yellowstone River, plus wells for supplementary source	1,440	710	500	Adding clarifier in summer of 1978. Expect to expand system if and when power plant units 3 and 4 become operational.
	Forsyth	Yellowstone River	44,640	280	1,300	No problems, no plans to expand.
Treasure	Hysham	Yellowstone	1,080	100	200	No problems. The system was expanded in 1977.
Wibaux	Wibaux	wells	252	70	100	New well will be added in summer of 1978 with 252,000 GPD pump capacity. Funds are being sought to finance additional storage facility.
Golden Valley, ND	Beach	wells	500	100	250	No problems, no plans to expand.
	Golva	well	20	10	27	Summer peak utilization frequently goes beyond capacity. Application for funding of additional well is pending. Construction of new well in summer of 1978 is expected to double the pumping capacity.

SOURCE: Lower Yellowstone Area Socioeconomic Analysis, Centaur Management Consultants, Inc., 1978.

TABLE 4-17

MAJOR COMMUNITIES WITH SEWAGE TREATMENT FACILITIES AS OF MARCH, 1978

County	Community	Treatment Type	System Capacity (Population)	Population Served (approximate)	Comments
Carter	Ekalaka	Treatment Plant	(500,000 GPD)	740 (about 100,000 GPD)	No problems, no plans to expand.
Custer	Miles City	Lagoon	10,000	9,700	Problems with odor. Plan to accept bids for construction of a new lagoon in summer of 1978. New facility is to accommodate a population of 20,000.
Dawson	Glendive	Lagoon	8,000	6,000	No significant problems, no plans to expand.
	Richey	Lagoon	Not Available	550	Lagoon must be pumped to a nearby pasture about twice a year. No plans to expand.
Fallon	Baker	Lagoon	Not Available	3,100	New lagoon added in 1977. No problems, no plans to expand.
	Plevna	Lagoon	500	180	No problems, no plans to expand.
Garfield	Jordan	Lagoon	900-1,000	530	No problems, no plans to expand.
McCone	Circle	Lagoon	2,000	1,200	No problems, but EPA discharge standards are not being met. A consulting engineer is studying the facility and expects to recommend improvements.
Powder River	Belle Creek	Lagoon	Not Available	125	No problems. Population at one time was at 500 and lagoon was adequate. No plans to expand.
	Broadus	Lagoon	825	825	Lagoon is working at capacity. Application for funding an addition to the lagoon is pending and construction is expected to occur in late 1978. Capacity will be increased to a population of 1,000.
Prairie	Fallon	Not Available	Not Available	Not Available	Not available.
	Terry	Lagoon	1,300	860	No problems, no plans to expand.
Richland	Fairview	Lagoon	2,000	550	No problems, but are attempting to solicit funding for new lagoon.
	Lambert	Lagoon	400	200	No problems, only 50% of the lagoon is being used to date.
	Savage	Lagoon	300	450	Lagoon is overloaded, attempting to obtain federal funding for additional cell.
	Sidney	Lagoon	12,000	5,000	No problems, no plans to expand.
Rosebud	Ashland	Lagoon	Not Available	650	System first became operational in March, 1977. No problems to date.
	Colstrip	Lagoon	2,000	2,200	A new lagoon to serve 5,000 people is under construction and will be operational by July, 1978.
	Forsyth	Lagoon	800	2,640	A consulting engineer is currently designing the specifications for a new lagoon system to accommodate a population of 5,000. Current lagoon has significant odor problem. Bids for construction of new facility will be accepted in the summer of 1978.
Treasure	Hysham	Lagoon	500	450	No problems at this time. The facility is being examined by an engineering firm.
Wibaux	Wibaux	Lagoon	1,200	670	No problems, no plans to expand.
Golden Valley, ND	Beach	Lagoon	1,500	1,400	New lagoon added in summer 1977. No problems, no plans to expand.
	Golva	Lagoon	50	100	Although design capacity is half of current utilization, there are no problems with the system and the town has no plans to expand the lagoon.

SOURCE: Lower Yellowstone Area Socioeconomic Analysis, Centaur Management Consultants, Inc., 1978.

TABLE 4-18

STUDY AREA NATURAL GAS SUPPLIERS

Company	Communities Served
Montana-Dakota Utilities Company (Glendive) Total on-line customers: 9,961 Residential : 8,467 Firm Commercial : 1,490 Industrial : 4	Baker Beach, North Dakota Fairview Glendive Golva, North Dakota Ismay Richey Savage Sentinel Butte, North Dakota Sidney Terry Wibaux
Montana-Dakota Utilities Company (Miles City) Total on-line customers: 5,132 Residential : 4,425 Commercial : 705 Industrial : 2	Forsyth Miles City Rosebud

SOURCE: ibid

TABLE 4-19

ELECTRIC UTILITIES SERVICING THE STUDY AREA

	COUNTIES SERVED														
	Big Horn	Carter	Custer	Dawson	Fallon	Garfield	McCone	Powder River	Prairie	Richland	Rosebud	Treasure	Wibaux	Golden Valley, ND	Source of Power
Montana-Dakota Utilities			x	x	x					x	x				D
Montana Power Company	x										x				A
Big Horn County Electric Cooperative, Inc.	x														A
Fergus Electric Cooperative, Inc.												x			A
Goldenwest Electric Cooperative, Inc.				x	x								x	x	B
Lower Yellowstone Electric Association				x						x					B
McCone Electric Cooperative, Inc.			x	x		x	x		x	x	x				B,C
Mid-Yellowstone Electric Cooperative, Inc.	x		x								x				C
Southeast Electric Cooperative, Inc.		x	x		x			x							B
Tongue River Electric Cooperative, Inc.	x	x	x	x	x			x	x		x				C
Valley County Electric Cooperative, Inc.							x								C
Yellowstone Valley Electric Cooperative, Inc.	x											x			C
McKenzie Electric Cooperative, Inc.										x			x	x	B

Key to Source of Power: A - Montana Power Company
B - Upper Missouri G&T Coop. (Bureau of Reclamation & Basin Electric Power Coop., Inc.)
C - Central Montana G&T Coop. (Bureau of Reclamation & Montana Power Company)

most commonly in the form of alcoholism and there is a need in the study area for a non-medical detoxification facility for alcoholics. Table 4-20 presents a summary of hospitals/beds by county.

Educational facilities in the study area are described as adequate with no tendency for overcrowding in the classrooms. Teacher turnover is considered high, even though there is evidently no problem recruiting qualified teachers into the area. Residents have historically voted for additional levies for educational purposes, although in the last five years Custer County has voted against increases in education related bonds. For these reasons, it is likely that any educational demands resulting from major increases in population could be handled either through the use of existing excess educational capacity or educational levies.

The housing stock in the study area is quite old with over 50% of the houses in 1970 being over 30 years old. Single family housing is the most prevalent form of housing in the study area, with single family housing and mobile homes accounting for about 85% of the study area's 1970 housing stock. Tables 4-21 and 4-22 summarize the most recent data available in the study area. There is currently a general shortage of rentals in the study area and any short term influx of people would encounter serious difficulty in finding rental housing to meet their needs. Most current building activity in the study area is geared toward the middle to high income home owner. Consequently, little is now being done to alleviate the existing rental shortage.

Western South Dakota

Population

The total population in the South Dakota portion of the study area increased from 182,173 in 1970 to an estimated 193,049 in 1975, representing a 6% increase during this five year period. Table 4-23 presents population forecasts for the years 1975, 1980, 1985, showing that Meade, Pennington, Shannon, Todd, and Lawrence Counties are expected to experience the greatest population growth during this ten year period.

Employment

Total employment levels in western South Dakota increased by 10.9% from 1971 to 1976. Todd, Shannon, and Pennington Counties experience the greatest percentage increase in employment during that period (Table 4-24).

During the year 1977, there was an average of four rigs at work per day in this portion of the study area. Assuming that each rig requires approximately 30 workers per 24 hour period (10 workers for each of the three 8-hour shifts), these four rigs would result in employment for approximatly 120 oil and gas workers areawide. This represents approximately 2.5% of the total 1976 employment in the Harding, Stanley, and Perkins portion of the study area in South Dakota where oil and gas activity is currently concentrated.

Income

Personal income increased by 56% from 1971 to 1976 (Table 4-25). Fall River and Shannon Counties showed the greatest percentage increase because of the growth in government and government services income in those counties. Assuming that the 1976 average annual salary of oil and gas workers was $18,000, the total estimated direct annual payroll ($2.2 million) for the 120 oil and gas workers in the Harding, Stanley and Perkins County area contributed 5.8% to the 1976 total personal income of these three counties.

TABLE 4-20

HOSPITALS, LICENSED BEDS, OCCUPANCY RATES,
AND BED/1,000 POPULATION RATIOS - 1977

County	Number of Hospitals	Number of Licensed Beds	Average Occupancy Rate (1976)	Beds/1,000 Population Ratio[1]	Bed Surplus (Deficit)
Carter	1	16	37.0[2]	8.9	4
Custer	2	216	56.9	16.6	40[3]
Dawson	1	46	56.5	4.1	1[4]
Fallon	1	19	71.1	4.9	5
Garfield	1	8	55.0[2]	4.4	4
McCone	1	20	44.7[2]	7.4	5
Powder River	0	--	--	--	
Prairie	1	8	75.0[2]	4.7	0
Richland	1	55	60.0[2]	5.3	(2)
Rosebud	2	18	47.0[2]	1.8	5[5]
Treasure	0	--	--	0	
Wibaux	0	--	--	0	
Study Area	11	406	55.3	6.1	70.5

1/ Based on 1976 population estimates, U.S. Bureau of the Census.

2/ Telephone communication with individual hospitals.

3/ Custer and Powder River Counties combined.

4/ Dawson and Wibaux Counties combined.

5/ Rosebud and Treasure Counties combined.

SOURCE: Montana Department of Health and Environmental Sciences, Division of Hospital and Medical Facilities, "Licensed Hospitals in the State of Montana," Helena, August 1977.

American Hospital Association, Guide to the Health Care Field, 1977 Edition, Chicago, Illinois 1977.

TABLE 4-21

YEAR-ROUND HOUSING UNITS
1970

County Community	Total Year-Round Housing Units	% of Units Within Study Area	Units in Structure					
			1 Unit		Mobile Home		Other	
			No.	%	No.	%	No.	%
Carter	721	3.6	616	85.4	73	10.1	32	4.4
Custer	4,316	21.7	3,132	72.6	263	6.1	921	21.3
Miles City	3,388	17.1	2,373	70.0	110	3.2	905	26.7
Dawson	3,700	18.6	2,662	71.9	275	7.4	763	20.6
Glendive	2,198	11.1	1,350	61.4	103	4.7	745	33.9
Fallon	1,357	6.8	1,021	75.2	172	12.7	164	12.1
Baker	864	4.4	628	72.7	104	12.0	132	15.3
Garfield	683	3.4	526	77.0	96	14.1	61	8.9
McCone	1,033	5.2	895	86.6	68	6.6	70	6.8
Powder River	954	4.8	675	70.8	228	23.9	51	5.3
Prairie	690	3.5	576	83.5	59	8.6	55	8.0
Richland	3,406	17.2	2,732	80.2	166	4.9	508	14.9
Sidney	1,636	8.2	1,229	75.1	52	3.2	355	21.7
Rosebud	2,032	10.2	1,579	77.7	217	10.7	236	11.6
Treasure	433	2.2	387	89.4	33	7.6	13	3.0
Wibaux	535	2.7	451	84.3	16	3.0	68	12.7
Study Area	19,860	100.0	15,252	77.7	1,666	8.4	2,942	14.8

SOURCE: U.S. Department of Commerce, Bureau of the Census, 1970 Census of Housing, Volume 1, "Housing Characteristics for States, Cities, and Counties," Parts 28 and 36, Washington, D.C. 1972.

TABLE 4-22

NEW HOUSING UNITS AUTHORIZED IN PERMIT ISSUING COMMUNITIES
1970-1976

County	Community	New Housing Units Authorized							Total New Units Authorized	% of Units Authorized in Study Area
		1970	1971	1972	1973	1974	1975	1976		
Carter	Ekalaka	1	--	1	--	--	--	--	2	.2
Custer	Miles City	16	78	139	27	33	62	91	446	48.3
Dawson	Glendive	--	5	13	10	44	15	42	129	14.0
	Richey	--	--	--	--	--	--	2	2	.2
McCone	Circle	3*	3	3*	2	5	21	11	48	5.2
Powder River	Broadus	--	2	--	1	3	3	10	19	2.1
Prairie	Terry	--	1	--	1	3	2	8	15	1.6
Richland	Fairview	1	2	--	1	4	2	4	14	1.5
	Sidney	10	19*	26	24	37	19	31	166	18.0
Rosebud	Forsyth	8	5	NR	17	3	33	11	77	8.3
Wibaux	Wibaux	--	--	1	--	--	2	2	5	.5
Study Area		39	115	183	83	132	157	212	923	100.0

*Less than entire year reported.
NR - not reported.

NOTE: All housing units authorized in permit issuing places are treated as non-farm even though a negligible number are located on farm property.

A housing unit is a house, apartment, room, or group of rooms intended for occupany as separate living quarters by a family, by a group of unrelated persons living together, or by a person living alone (Bureau of the Census).

SOURCE: Ibid

TABLE 4-23

POPULATION ESTIMATES
(SOUTH DAKOTA PORTION)

County	1970	1975	1980	1985	% Change 1975-1985
Bennett	3,088	3,286	3,418	3,686	12.2
Butte	7,825	8,333	7,839	8,060	- 3.4
Corson	4,994	5,076	5,296	5,631	10.9
Custer	4,698	5,077	4,715	4,731	- 7.3
Dewey	5,170	5,976	5,814	6,359	6.4
Fall River	7,505	8,048	6,681	6,411	-25.5
Gregory	6,710	6,575	6,645	6,779	3
Haakon	2,802	2,823	2,851	3,051	8.1
Harding	1,855	1,842	1,835	1,868	1.4
Jackson	1,531	1,605	1,503	1,530	- 4.9
Jones	1,882	1,722	1,931	1,989	15.5
Lawrence	17,453	17,003	18,170	18,777	10.4
Lyman	4,060	4,083	4,530	4,926	20.6
Meade	17,020	18,069	18,316	19,576	8.3
Mellette	2,420	2,349	2,596	2,731	16.2
Pennington	59,349	65,511	66,822	70,903	8.2
Perkins	4,769	4,721	4,639	4,671	1.1
Shannon	8,198	9,110	10,362	11,938	31
Stanley	2,457	2,565	2,383	2,375	- 8
Todd	6,606	7,245	7,927	8,946	23.4
Tripp	8,171	8,166	8,317	8,585	5.1
Washabaugh	1,389	1,527	1,695	1,884	23.3
Ziebach	2,221	2,337	2,448	2,651	13.4
23-County Total	182,173	193,049	196,733	208,058	7.8

SOURCE: South Dakota Population Projections, State Planning Bureau, Pierre, South Dakota 12/78.

TABLE 4-24

TOTAL EMPLOYMENT IN STUDY AREA
(SOUTH DAKOTA PORTION)

County	1971	1973	1975	1976	% Change 1971-76
Bennett	1,193	1,233	1,245	1,248	4.6
Butte	3,199	3,289	3,295	3,380	5.7
Corson	1,608	1,667	1,733	1,737	8.0
Custer	1,949	2,035	2,104	2,136	9.6
Dewey	2,396	2,458	2,432	2,463	2.8
Fall River	3,267	3,155	3,189	3,310	1.3
Gregory	2,749	2,767	2,744	2,744	--
Haakon	1,367	1,467	1,580	1,524	11.5
Harding	970	1,042	1,030	987	1.8
Jackson	758	902	872	874	15.3
Jones	1,010	988	972	986	-0.1
Lawrence	6,804	6,724	7,261	7,597	11.7
Lyman	1,963	1,861	1,845	1,869	-5.0
Meade	4,476	4,826	4,949	5,041	12.6
Mellette	899	778	762	784	-12.8
Pennington	31,317	34,159	34,812	36,140	15.4
Perkins	2,404	2,506	2,587	2,613	8.7
Shannon	1,820	2,031	2,438	2,449	34.6
Stanley	939	1,041	1,036	1,171	24.7
Todd	2,194	2,375	2,720	2,651	20.8
Tripp	3,741	3,656	3,625	3,693	-1.3
Washabaugh	325	336	384	376	15.7
Ziebach	836	962	1,016	970	16.0
23-County Total	78,184	82,248	84,641	86,743	10.9

SOURCE: Regional Economic Information System, U.S. Department of Commerce 1976.

TABLE 4-25

TOTAL PERSONAL INCOME
($000)
(SOUTH DAKOTA PORTION)

County	1971	1973	1975	1976	% Change 1971-1976
Bennett	8,821	18,490	12,585	11,212	27.1
Butte	26,766	37,197	36,177	40,070	49.7
Corson	13,131	22,619	19,368	17,198	31.0
Custer	14,941	20,052	21,554	23,893	59.9
Dewey	15,187	23,372	19,937	20,315	33.8
Fall River	23,968	41,635	46,381	53,117	121.6
Gregory	20,426	34,735	28,139	29,012	42.0
Haakon	11,584	25,267	18,466	13,313	14.9
Harding	7,792	14,334	8,740	7,562	-3.0
Jackson	5,339	10,355	7,888	6,926	29.7
Jones	6,638	12,293	8,428	6,469	-2.5
Lawrence	55,466	67,043	84,548	95,118	71.5
Lyman	13,814	27,910	16,666	13,055	-5.5
Meade	64,453	88,446	89,353	93,055	44.4
Mellette	7,320	12,726	8,694	8,852	20.9
Pennington	228,405	299,925	355,014	396,835	73.7
Perkins	17,944	29,555	21,897	22,427	25.0
Shannon	11,520	19,583	21,493	22,390	94.4
Stanley	8,112	17,941	7,367	7,719	-4.8
Todd	15,263	24,028	23,670	24,264	59.0
Tripp	29,577	51,528	37,585	37,578	27.1
Washabaugh	3,468	7,504	3,937	2,936	-15.3
Ziebach	5,630	10,094	8,719	6,886	22.3
23-County Total	615,565	917,442	906,606	960,202	56.0

SOURCE: Regional Economic Information System, U.S. Department of Commerce 1976.

LAND USE

Surface Ownership and Public Land Title Security

Surface ownership (see Table 4-26) within the Miles City District, which also includes the state of South Dakota, consists of a mixture of private, state, and federal lands encompassing over 142 million acres. Of this acreage, the Bureau of Land management administers over 3 million acres of the total acres within the district. The majority of public lands are located in the western and northwestern parts of the Big Dry and Powder River Resource Areas in eastern Montana. Lands in South Dakota are located primarily in the western part of the state near the towns of Lead, Deadwood, and Sturgis. Figure 4-30 shows the surface ownership pattern in the district.

In the Montana portion of the district, there are approximately 2,085,530 acres of vacant public lands and approximately 522,444 acres of lands commonly referred to as "LU" lands. The LU lands differ from vacant public lands in that they were purchased from the United States by early settlers. For many reasons (primarily lack of irrigable water), these early homesteaders found it impossible to make an economic livelihood off the LU lands and sold them back to the government under an act known as the Bankhead-Jones Act. With advancements in agricultural technology now available, many of the LU lands have a high potential for agricultural production. Many of these lands would also be suitable for residential, commercial, and industrial development. As such, LU lands present BLM with many new aspects of land management, particularly since the laws under which these lands are administered are different than those which apply to vacant public lands. There are no LU lands in South Dakota which are administered by BLM.

Approximately 64,326 acres of public lands have been withdrawn from the public land laws in the Montana portion of the district. The largest withdrawal is for the Fort Keogh Livestock Experiment Station near Miles City which is administered by the Department of Agriculture. The smallest withdrawal (12 acres) is for a city park in Miles City which is administered by BLM. In South Dakota, the largest withdrawal under BLM's administration is for the Fort Meade Recreation Area which encompasses over 6,600 acres. Other types of withdrawals in the district include reclamation, public water reserves, stock driveways, townsites, and power site withdrawals.

Originally, the lands in Montana and most of the lands in South Dakota were part of the Louisiana Purchase and were acquired from France in 1803. A small portion of the lands in northeastern South Dakota were acquired from Mexico through the Gadsden Purchase in 1853.

Through the passage of the Homestead Act (1909), Stock Raising Homestead Act (1916), and land grants to the railroads, a large portion of the public domain lands were retired from federal ownership. Many of the lands which were not claimed (during the passage of these Acts) are lands administered by the Bureau of Land Management.

In southeast Montana many of the BLM lands are scattered and fragmented ranging in size from 40-200 acres and are completely surrounded by lands held in private ownership. This type of situation has in the past led to many unauthorized (and indiscriminate) uses of BLM lands. Use of BLM lands for utilities, agriculture and livestock grazing, and for housing sites without proper authorization has been a frequent source of problems (mainly trespass related) for BLM in the past 20 years in the Miles City District. However, many of these problems were created during a period of time when the Bureau had little or no Congressional authority for managing the public lands.

On October 21, 1976, Congress passed the Federal Land Policy and Management Act (FLPMA) which launches a new era for the Bureau in the adminisstration of public lands. Among other things, the Act allows for public lands to be developed for small trade and manufacturing firms, to be cultivated, and for residential and urban uses. Certainly, the act will allow the Bureau to permit a variety of surface uses where previously it had no authority to do so. Although this new authority will help to alleviate past land use conflicts, managers will ultimately be faced with making decisions to provide resource comprises which allow these additional uses on public lands as provided in the Act. And, a number of policy issues have yet to be resolved. For example, should BLM contribute to the wheat oversupply problem by authorizing additional cropping on public lands? The answers to these and other questions will have significant impacts upon BLM's administration in the future.

TABLE 4-26

MILES CITY DISTRICT
SURFACE LAND OWNERSHIP

(Southeastern Montana)

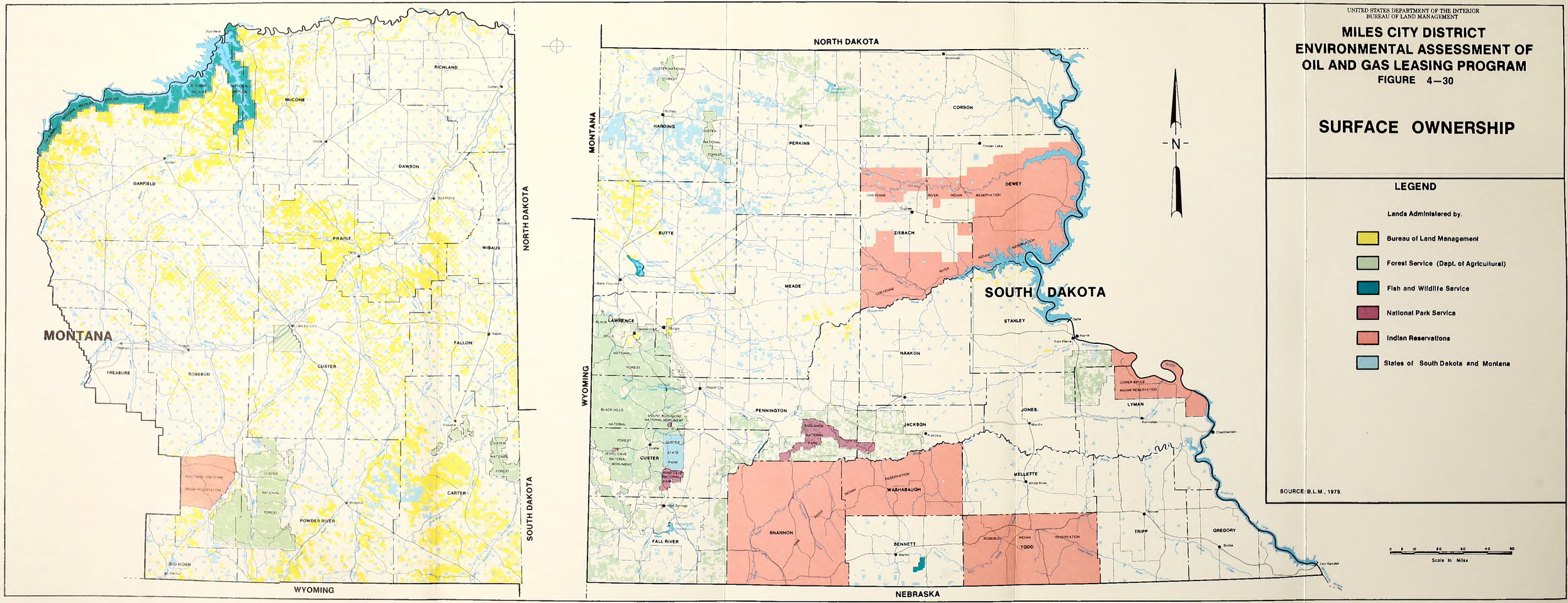
	Total Acres	BLM Acres	% BLM	Forest Service Acres	% Forest Service	Other Acres	% Other
MONTANA	94,168,320	8,141,524	9	16,704,075	18	68,137,555	73
COUNTY							
Dawson	1,516,800	67,516	4	--	--	1,449,274	96
Garfield	2,851,200	517,207	18	--	--	2,333,993	82
McCone	1,668,480	203,082	12	--	--	1,465,398	88
Prairie	1,107,200	450,135	41	--	--	657,065	59
Richland	1,330,560	53,062	4	--	--	1,277,498	96
Wibaux	569,600	25,882	5	--	--	543,718	95
Carter	2,120,320	511,427	24	89,400	4	1,519,493	72
Custer	2,403,840	341,970	14	--	--	2,061,870	86
Fallon	1,045,120	121,945	12	--	--	923,175	88
Powder River	2,104,320	260,028	12	341,946	16	1,502,346	71
Rosebud	3,223,680	230,010	7	95,827	3	2,889,843	90
Treasure	630,400	11,884	2	--	--	618,516	98
Big Horn	3,214,720	26,759	1				

(South Dakota)

	Total Acres	BLM Acres	% BLM	Other Federal	% Other Federal	Indian	% Indian	State	% State	Private	% Private
SOUTH DAKOTA	48,613,748	276,297	.5	3,124,507	6	4,867,438	10	2,105,714	4	38,239,792	79
COUNTY											
Bon Homme	358,400	58		16,915	5	40		10,112	3	331,275	92
Brule	523,520	551		14,782	3	149		20,321	4	487,717	93
Buffalo	308,480	13		21,494	7	60,328	20	3,981	1	222,664	72
Butte	1,440,000	145,891	10	15,841	1			102,308	7	1,175,960	82
Campbell	468,480	361		23,566	5			20,236	4	424,317	91
Charles Mix	702,080	176		32,406	5	34,017	5	25,705	4	609,776	87
Clay	259,200	11		40				7,825	3	251,324	97
Coddington	439,680	3		2,010		1,002		38,717	9	397,948	91
Custer	996,480	3,900		400,182	40			92,490	9	499,908	50
Fall River	1,115,520	6,823	1	287,339	26			39,438	4	781,920	70
Gregory	638,080	172		28,707	4	16,976	3	16,226	3	575,999	90
Haakon	1,162,240	1,400		2,252				27,319	2	1,131,269	97
Harding	1,716,480	29,880	2	73,641	4			330,531	19	1,282,428	74
Hughes	478,720	55		45,656	10	27,857	6	9,694	2	395,458	83
Jackson	517,120	427		120,606	23			15,060	3	381,027	74
Jones	622,720	83		20,032	3			13,873	2	588,732	95
Lawrence	512,000	4,918	1	269,057	53			10,760	2	227,265	44
Lincoln	368,640	70		180				13,873	4	354,883	96
Lyman	1,077,120	192		119,125	11	95,914	9	32,420	3	829,469	77
Meade	2,217,600	35,407	2	37,473	2	160		94,753	4	2,049,807	92
Pennington	1,778,560	17,482	1	792,302	45	640		46,505	3	921,631	52
Perkins	1,830,400	9,227	1	150,303	8	640		85,917	5	1,584,313	87
Potter	556,160	40		19,099	3			35,875	6	501,146	90
Roberts	709,120	24		3,964	1	65,513	9	35,241	5	604,378	85
Stanley	904,960	16,824	2	97,964	11	15,801	2	20,401	2	753,970	83
Sully	642,560	166		69,946	11			29,814	5	542,634	84
Union	289,280	1,784	1	96				11,065	4	276,335	96
Yankton	332,160	359		3,308	1			19,976	3	317,517	96

NOTE: "Other" includes state, county, private, and other federal acres.
Total BLM lands within the district = 3,078,445.

SOURCE: U.S.D.I. Bureau of Land Management 1975
Public Land Statistics 1976



UNITED STATES DEPARTMENT OF THE INTERIOR
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MILES CITY DISTRICT ENVIRONMENTAL ASSESSMENT OF OIL AND GAS LEASING PROGRAM

FIGURE 4—30

SURFACE OWNERSHIP

LEGEND

Lands Administered by:

- Bureau of Land Management
- Forest Service (Dept. of Agricultural)
- Fish and Wildlife Service
- National Park Service
- Indian Reservations
- States of South Dakota and Montana

SOURCE: B.L.M., 1979.

Scale in Miles

Agricultural Land Use

Economically, agriculture is one of the main industries in southeast Montana and the two principal staple products are "wheat and meat."

Most agricultural production results from dryland farming and ranching; a small part of the land is irrigated.

Livestock production consists primarily of cattle, sheep, and hogs. The principal farm crops are wheat, barley, flax, rye, oats, corn, alfalfa, and sugar beets. Poultry, eggs, and dairy products are important in some localities.

In many ranching operations, horses still provide a major source of transportation and are frequently used in locating and herding livestock in some of the rugged badland areas typical of southeastern Montana.

Private, gricultural land use is generally broken down into four (4) major categories, namely: irrigated, non-irrigated, grazing, and wild haylands. Table 4-27 shows the number of acres and the various percentages for each of these categories for each of the counties in southeastern Montana. No information for these different uses was available for South Dakota.

Federal lands are categorized as non-cropland in most resource inventories, and are used almost exclusively for grazing. In Montana, BLM lands furnish about 7 percent of the feed requirements for beef cattle and sheep on spring, summer, and fall rangelands. BLM lands are highly significant in that they provide a source of feed during certain portions of the year when privately owned lands cannot be used for one reason or another. In many cases, BLM lands are the key to an economic and stable livestock operation for Montana ranchers.

The cropland includes irrigated and non-irrigated acreage and is capable of producing dryland grains and diversified crops. The highest potential for the latter is in areas along the Missouri and Yellowstone Rivers and their major tributaries such as the Tongue and Powder Rivers near Miles City, Montana. In recent years, there has been an increase in dryland farming practices. This trend has resulted, among other things, from previous record low market prices for livestock, particularly cattle, forcing many ranchers to switch to other agricultural practices in order to maintain an economic livelihood. This has resulted in significant land use changes and many acres of rangeland, pasture land, and hay lands have been converted to croplands. Available data suggests that a higher percentage of less productive and more erodible lands are being brought into crop production.

With new advances in agriculture techniques, together with BLM's new charter under FLPMA which allows farming, a high potential exists for producing a variety of different crops on public lands.

Scattered non-commercial Ponderosa Pine and Juniper forests occupy about 10% of the land area, but contribute very little to the forest product base in southeast Montana. However, in South Dakota, especially in the western part of the state, the Black Hills National Forest supports an active and ever increasing timber indusry.

Urban/Suburban Land Use

Use of BLM lands in southeastern Montana for urban-suburban purposes include a sanitary landfill site and a rifle range at Terry, a state part at Glendive, and a recreation area immediately east of Miles City. Also, within the city limits of Miles City there are two small tracts of BLM lands being used for park purposes, one for a water treatment facility, and two more used for grazing and open space. Two areas along the Yellowstone River, one near the town of Fallon, and one near the town of Savage are used for fishing access sites.

Except for Miles City, BLM lands are not conveniently located near major communities to accommodate urban-suburban uses. Sidney and Glendive have both developed comprehensive land use plans which provide for their future expansion needs. BLM lands were not identified in their plans as being necessary to meet any community needs. Except for Sidney and possibly Circle, Montana, which anticipates the development of an ammonia fertilizer plant within the next five years, urban/suburban sprawl of the other communities is not expected to expand outside the city limits within the near future. Although no new townsites have been planned for Circle and Sidney, Montana, it is possible BLM lands may be needed for such uses in the near future.

In South Dakota, especially in and near the towns of Lead, Deadwood and Sturgis, BLM lands have been used extensively for residential homesites, rifle and archery ranges, ski lifts, cemeteries, and a variety of other public purpose uses. The Fort Meade Recreation Area near Sturgis is a 6,693 acre block of BLM lands that receives heavy recreational pressure on a year-round basis.

TABLE 4-27

AGRICULTURAL LAND USE BY COUNTY
(SOUTHEASTERN MONTANA)

County	Irrigated Acres	(%)	Non-Irrigated Acres	(%)	Grazing Acres	(%)	Wild Hay Acres	(%)	Total
Big Horn	38,268	(3)	87,583	(6)	1,239,697	(89)	22,822	(2)	1,388,370
Carter	--	-	75,725	(5)	1,261,764	(91)	46,683	(3)	1,384,172
Custer	25,777	(1)	59,250	(3)	1,749,551	(95)	19,984	(1)	1,854,562
Dawson	14,941	(1)	398,933	(30)	913,549	(69)	6,116	-	1,333,539
Fallon	--	-	158,337	(19)	653,430	(78)	22,461	(3)	834,228
Garfield	321	-	163,049	(8)	1,909,646	(92)	9,829	-	2,082,845
McCone	4,126	-	472,267	(35)	852,991	(64)	5,737	-	1,335,121
Powder River	1,244	-	66,806	(4)	1,225,168	(91)	50,410	(4)	1,343,628
Prairie	10,759	(2)	89,460	(15)	470,144	(81)	8,324	(1)	578,687
Richland	40,940	(3)	379,221	(32)	739,078	(63)	19,052	(2)	1,178,291
Rosebud	25,647	(1)	100,769	(4)	2,251,002	(94)	24,469	(1)	2,401,887
Treasure	16,461	(3)	17,250	(3)	514,495	(94)	460	-	548,666
Wibaux	--	-	139,022	(28)	355,937	(70)	10,041	(2)	505,000
TOTAL	178,484		2,207,672		14,136,452		246,338		16,768,996

NOTE: Similar information not available for South Dakota.

SOURCE: Montana Department of Revenue 1978.

Oil, Gas, and Coal Industry Land Use

Second only to the agricultural and livestock industry, oil and gas activities contribue significantly to the local economy. In 1978 approximately 18.5 million barrels of oil and 8.2 million mcf of gas were extracted from 11 of the counties in southeast Montana. Gross value of these products was approximately $171 million. (Report of the State Department of Revenue 1978.)

Sidney and Glendive, Montana, are the only communities experiencing significant growth as a direct result of oil and gas exploration activities. Smaller communities such as Savage, Lambert, and Richey which are located near oil and gas exploration activities receive spinoff benefits such as increased sales of gas, oil, and higher demands for the limited amount of goods and services which they can provide.

Although the recent discovery of oil and gas in production quantities has boosted the economy of the Sidney community, the town itself is lacking in city services, housing, and other facilities necessary to support its booming population. Public lands near Sidney are continually being explored for energy-related products and the Bureau's oil and gas leasing program for this area has rapidly increased within the last year.

Unlike southeastern Montana, western South Dakota is not experiencing a boom in oil and gas exploration activities. Part of the exploration activities have been concentrated near the Buffalo Creek and Bull Creek oil fields in Harding County and near the town of Hot Springs in Fall River County. However, most of the exploration activities have resulted in dry holes. Significant growth is not expected as a result of increased oil and gas activities.

Major oil and gas pipelines (re: Figure 4-7) are located in southeastern Montana and transport petroleum products to and from the Cedar Creek, Pine, and Pennel oil fields. All of these fields are located in Fallon County and in 1976 they accounted for 53% of Montana's crude oil production (Montana Department of Natural Resources and Conservation 1976). Oil from these fields, as well as smaller fields, is purchased by the Butte Pipeline Company (Evertt Knipp, personal communication) and transported via a 16-inch pipeline to Fort Laramie and Gurnsey terminals in Wyoming (Bob Alexander, personal communication).

An 8-inch pipeline operated and maintained by the Cenex Refinery carries refined petroleum products (gasoline, diesel fuel, etc.) from Billings, Montana, to Minot, North Dakota.

Several gas pipelines operated and maintained by Montana-Dakota Utilities Company intersect various portions of southeastern Montana. The majority of natural gas is purchased and transported north from Worland, Wyoming, via a 12-inch line to a gathering station near Baker, Montana. From here the gas is transported to North and South Dakota (Les Seeman, personal communication). Figure 4-7 also shows the major natural gas pipelines in South Dakota.

The Northern Tier Pipeline (Figure 4-31), which would transport Alaskan and foreign crude oil from the west coast to the northern and inland states, will cross the northwestern part of the Miles City District. The 42-inch mainline originates at Port Angeles, Washington, and terminates at Clearbrook, Minnesota. Near Harlowton, Montana, the line diameter is reduced to 40 inches. Tentatively, the Northern Tier Company plans to deliver oil to an existing line serving Billings and Laurel, Montana. Other delivery points are planned near Sioux Pass, Montana, and Williston, North Dakota. The total planned capacity for this line is 933,000 barrels of oil per day.

The Northern Tier Pipeline would not cross any wilderness areas in the Miles City District.

The Northern Border Pipeline (Figure 4-31) will transport natural gas via a 42-inch pipeline from the Port of Morgan in Canada through northern Montana, eventually terminating in Ventura, Iowa. Tentatively this pipeline is not planned to intersect the Miles City District. However, if negotiations with the Fort Peck Indian Reservation reach an impass, an alternate route paralleling the south bank of the Missouri River would cross the northern portion of the Miles City District.

Construction on these two pipelines is not scheduled to begin until sometime in 1980-81.

With continual increases in the price for foreign oil (and foreseeable cutbacks in Canadian oil exports), the need for natural gas and petroleum related products will probably increase in future years. Certainly, BLM lands will be needed to provide authorized right-of-way corridors for the transportation of these natural resources products.

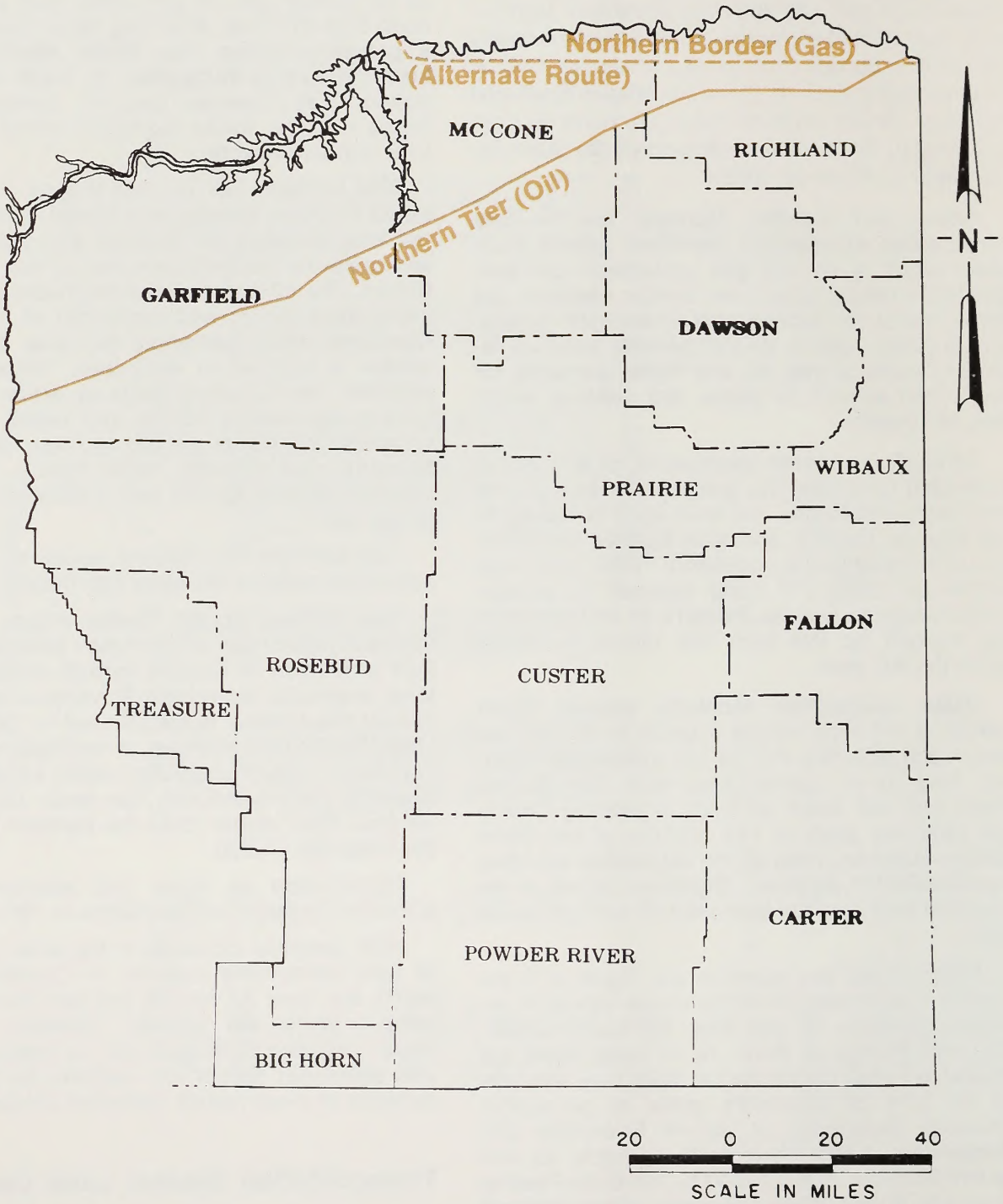
Transportation System Land Use

Roads and Highways

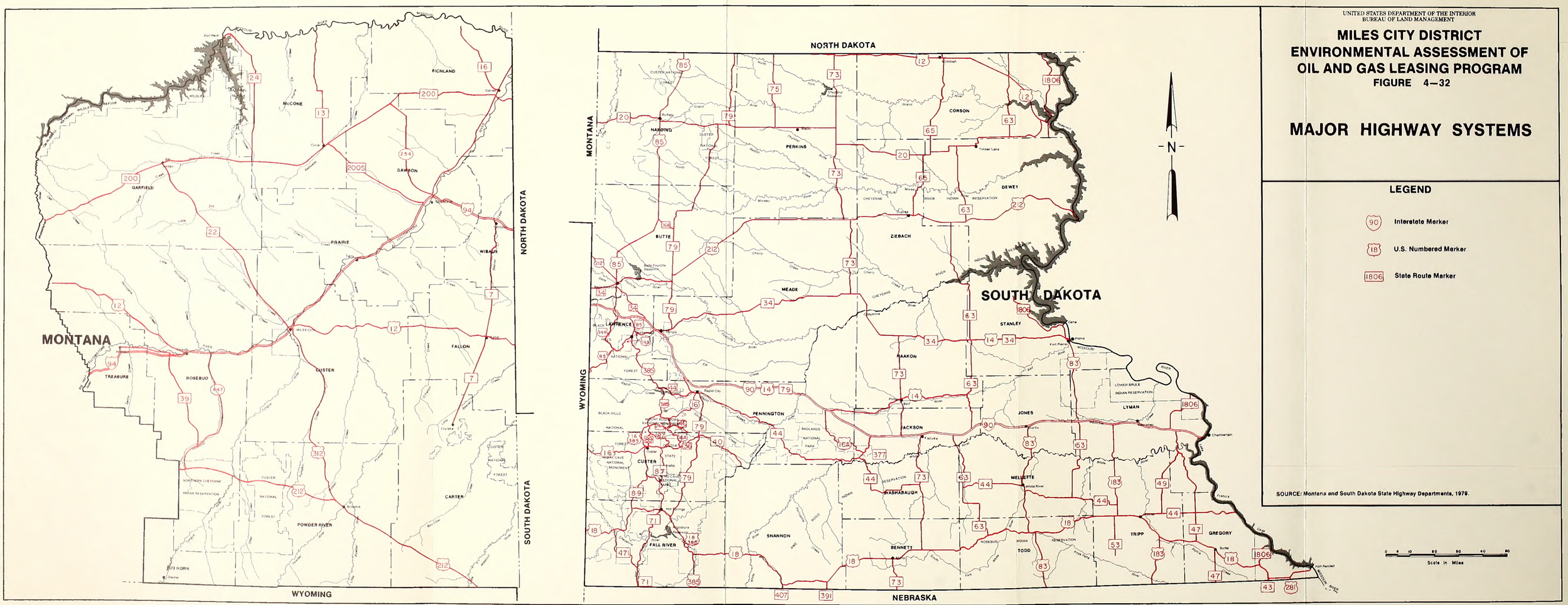
Vehicle traffic routes are shown in Figure 4-32. Of major importance is Interstate Highway 94 intersecting the southeastern Montana portion of the District and Interstate 90 which passes through the lower south half of South Dakota. These two high-

FIGURE 4—31

PROPOSED ROUTES-NORTHERN BORDER AND NORTHERN TIER PIPELINES



SOURCE: Northern Tier Pipeline Company, 1979 and Northern Border Pipeline Company, 1979.



UNITED STATES DEPARTMENT OF THE INTERIOR
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MILES CITY DISTRICT ENVIRONMENTAL ASSESSMENT OF OIL AND GAS LEASING PROGRAM

FIGURE 4—32

MAJOR HIGHWAY SYSTEMS

LEGEND

- 90 — Interstate Marker
- 18 — U.S. Numbered Marker
- 1806 — State Route Marker

SOURCE: Montana and South Dakota State Highway Departments, 1979.

ways provide a direct link to the major population centers and play a significant role in providing access to and from oil and gas areas.

Generally, the major roads and highways are maintained in good condition by local state and county highway departments. Occasionally, road closures are necessary due to periods of inclement weather.

Because of BLM's scattered land pattern legal access to public lands in the district is minimal. Although permission to cross private lands is generally granted upon asking permission to do so, the lack of legal access seriously affects the title security of the public lands and their resource programs.

Railroads

Rail freight service (Figure 4-33) in southeast Montana is provided by the Burlington Northern (BN), Chicago, Milwaukee, St. Paul, and Pacific (Milwaukee) Railroads. Both the BN and Milwaukee carry a variety of similar commodities (Table 4-28) to and from various points in the study area. However, in 1976 farm-related products comprised the majority (49%) of freight carried by BN while over 75% of the freight carried by the Milwaukee line consisted of energy-related products, primarily coal and petroleum products.

Recently, there has been a proposal to abandon a portion of the Milwaukee Railroad west of Miles City. Since most of the energy-related products are shipped east from Miles City, abandonment of this rail line would have virtually no effect on the amount of energy-related products hauled by the Milwaukee (Gary New, personal communication).

In South Dakota (Figure 4-33), the Chicago Northwestern and the Milwaukee Road are the primary railroads. The major commodities (Table 4-28) carried by the Chicago Northwestern include stone, clay, and glass products (31%) with farm products, non-metallic minerals, and lumber comprising 49% of the other major transported commodities. Energy-related products account for only 2% of the total transported products. The Milwaukee railroad transports over half (52%) of its products in the form of coal. Petroleum products are infrequently transported in minor insignificant quantities. Farm products account for 20% of the total transported commodities.

The Burlington Northern Railroad, although relatively small in comparison to the major lines, provides transportation needs in the extreme western portion of South Dakota. Energy-related products, mainly coal, account for 23% of the total transported products. Farm products (22%) and food and kindred products (18%) make up the two other most important transported commodities.

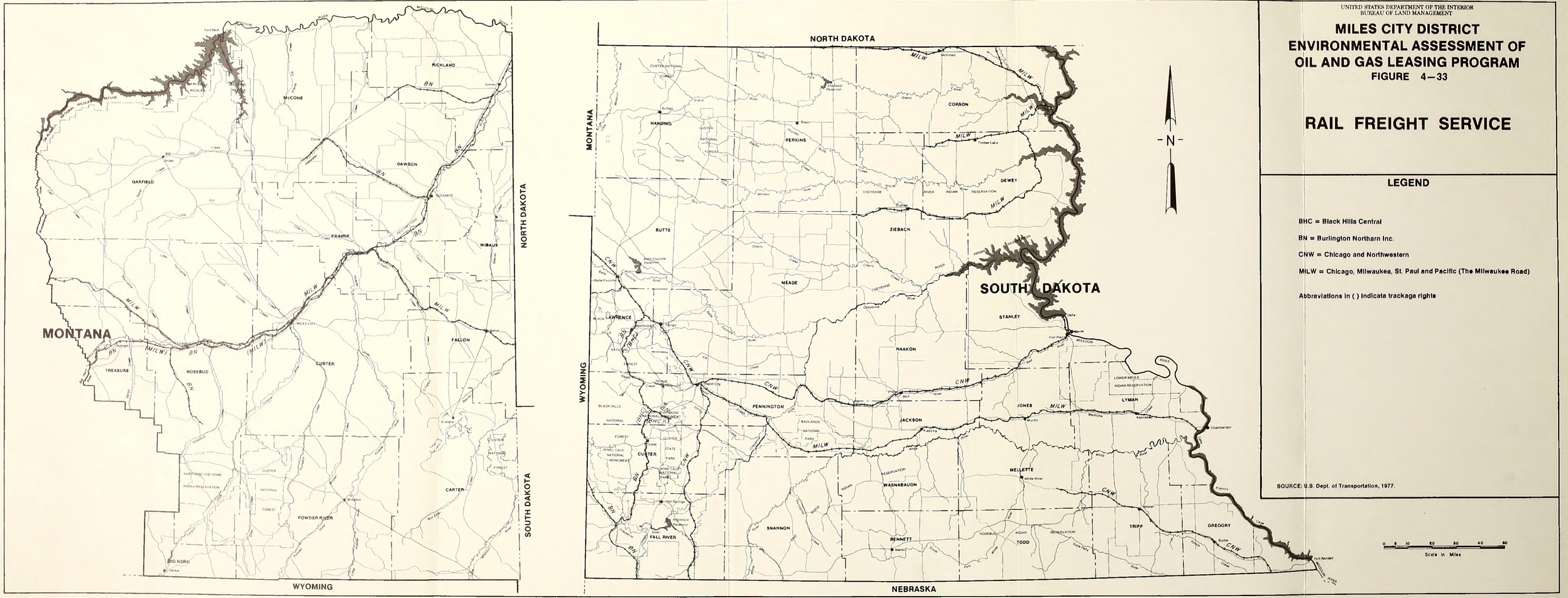
Utilities

Powerlines/Communication Facilities

In southeastern Montana, electrical power (Figure 4-34) is supplied by Montana-Dakota Utilities Company and is transported via a 57 kV line from Forsyth to Miles City, Montana. Montana-Dakota Utilities and the Tongue River Electric Cooperative, Inc., tap a portion of their electrical energy from a 115 kV transmission line. It runs from a Dawson County substation to Miles City and is maintained by the Western Area Power Administration.

A 230 kV line from Glendive to the Yellowtail Dam is a main east-to-west transmission line. Energy from this line is transported from Dawson to Custer County where electrical power is purchased by local cooperatives and distributed to the consumer. Several other 115 kV transmission lines service the northeastern portion of Montana.

In South Dakota (Figure 4-34), two large 230 kV transmission lines, also administered by the Western Area Power Administration, cross the western part of the state. Local cooperatives supply a portion of their electrical power from these lines for distribution to their subscribers. Several smaller lines (115 kV) also service western South Dakota.



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MILES CITY DISTRICT ENVIRONMENTAL ASSESSMENT OF OIL AND GAS LEASING PROGRAM

FIGURE 4—33

RAIL FREIGHT SERVICE

LEGEND

BHC = Black Hills Central

BN = Burlington Northern Inc.

CNW = Chicago and Northwestern

MILW = Chicago, Milwaukee, St. Paul and Pacific (The Milwaukee Road)

Abbreviations in ( ) indicate trackage rights

SOURCE: U.S. Dept. of Transportation, 1977.

TABLE 4-28

PRINCIPAL COMMODITIES CARRIED BY THE MAIN LINE HAUL CARRIERS

Montana (1976)

Commodity	Burlington Northern		Chicago, Milwaukee St. Paul and Pacific	
	Number of Tons	% of Total	Number of Tons	% of Total
Coal	588	-	24,728,535	74.5
Farm Products	618,245	48.6	3,231,826	9.7
Food & Kindred Products	62,915	5.0	289,948	.9
Lumber & Wood Products, except Furniture	195,813	15.4	2,189,644	6.6
Nonmetallic Minerals, except Fuels	123,242	9.7	752,862	2.3
Petroleum & Coal Products	-	-	571,377	1.7
Primary Metal Products	62,577	5.1	377,223	1.1
Pulp, Paper & Allied Products	190,156	15.0	226,785	.7
Stone, Clay & Glass Products	6,570	.5	480,567	1.5
Subtotal	1,262,106	99.3	32,848,767	99.0
Other	9,068	.7	338,147	1.0
Total Freight	1,271,174	100.0	33,186,914	100.0

*Freight originating includes freight loaded initially onto carrier and freight transferred onto carrier from a connecting railroad. Destination of freight could be either within or outside of Montana.

NOTE: Figures are state totals.

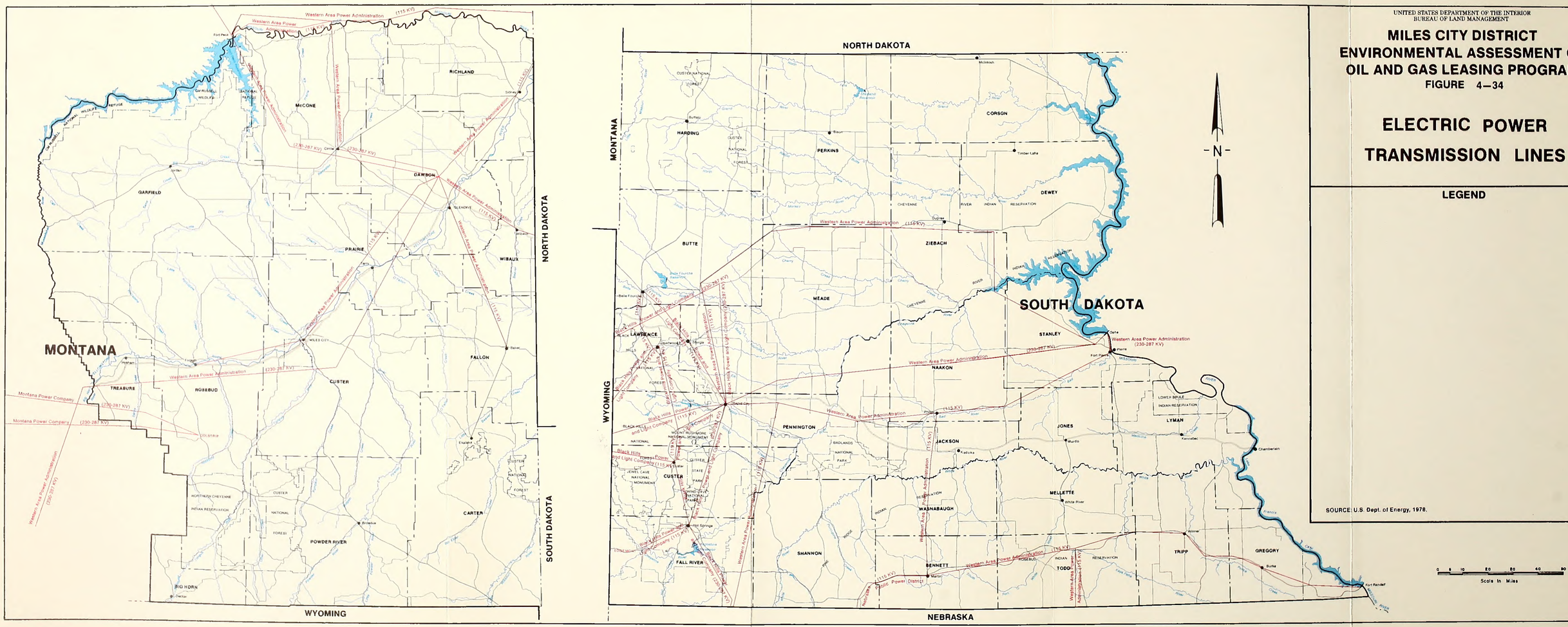
SOURCE: R-1 Annual Reports filed by railroad companies with the Public Service Commission, Helena, Montana 1976.

South Dakota (1976)

Commodity	Chicago-North Western		Milwaukee	
	Number of Carloads	% of Total	Number of Carloads	% of Total
Coal	327	1	24,000	52.0
Farm Products	5,084	16	9,412	20.0
Food & Kindred Products	2,589	8	1,926	4.0
Lumber & Wood Products	4,881	16	1,330	3.0
Nonmetallic Minerals, except Fuels	5,269	17	2,751	6.0
Petroleum & Coal Products	287	1	137	--
Primary Metal Products	278	1	362	1.0
Pulp, Paper & Allied Products	433	1	356	1.0
Stone, Clay & Glass Products	9,885	31	2,866	6.0
Other	2,398	8	3,047	7.0
TOTAL	31,431	100	46,187	100.0

These statistics include carloads originating or terminating within the state of South Dakota.

SOURCE: From information contained in the Annual Reports of the Railroads to the Interstate Commerce Commission. Prepared by the South Dakota Department of Transportation. Division of Railroads.



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MILES CITY DISTRICT ENVIRONMENTAL ASSESSMENT OF OIL AND GAS LEASING PROGRAM

FIGURE 4—34

ELECTRIC POWER TRANSMISSION LINES

LEGEND

SOURCE: U.S. Dept. of Energy, 1978.

CHAPTER 5

CHAPTER 5

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APPENDIX

APPENDIX 1-1

ASSUMPTIONS AND GUIDELINES

Because this assessment considers the possible exploration, development, and production of oil and gas from federal leases, it is necessary to outline several of the physical/operational characteristics which can be expected of the average drilling facility in Montana and the Dakotas. For analytical purposes, the assumption is made that any leasing action can result in oil and gas production, although historically only a small percentage of leases issued have gone into the production stage. Below are assumptions and guidelines which will be useful in the analysis of potential impacts resulting from oil and gas development.

Technology

For purposes of this analysis, it is assumed that the technology of oil and gas production will not change significantly. This assumption may not be objectively valid, but it is difficult to determine what direction improved technology may take in the future.

Supply and Demand

Many factors significantly affect oil and gas activity in the study area. For instance, demand for domestic oil and gas may decrease due to development of new energy sources. Alternatively, it may increase because of export restrictions imposed by foreign oil and gas suppliers or because of import restrictions imposed by the U.S. It is possible that a major oil or gas field could be discovered in the study area, resulting in increased activity. Since there is no way to accurately predict these changes, it is assumed that supply, demand, and production activity will follow current trends.

Preliminary Exploration

Preliminary exploration activity is expected to increase at a rate of about 10% a year, with most of it in the deep formations. Exploratory drilling is expected to increase at a rate of about 15% a year, in response to an increasing demand for petroleum products. Drilling is expected to be in the deep formations and on the fringes of existing fields. Development is expected to continue at about the current level as existing fields are further exploited. Production has decreased at about 2% annually over the last several years as reserves have been depleted, and it is anticipated that this trend will continue during the short run. Abandonments are expected to increase at a rate of about 5% a year as older fields are depleted.

Land for Producing Facilities

Land-use intensity decreases as well-spacing increases. The land use by all facilities in a developed field may range from more than 64 acres per square mile, with a 40-acre-per-well spacing, to about 4 acres per square mile with 640-acre-per-well spacing. These acreages are adequate for most field operations. The amount of land actually used may be greater in some areas and less in others. Most spacing patterns for oil wells on federal leases require a minimum of 40 acres per well.

Land use in gas fields is usually less than in oil fields because gas production usually does not require storage on the lease. Most patterns for production of gas on federal leases require spacing of 160, 320, or 640 acres per well.

Employment

The number of people required to operate a field varies with production and the number of leaseholds in the field. If the wells flow without pumping, one employee in a large, automated field can control production of about 25 wells. When wells are pumped, one employee in a large modern field can control production on 10 to 20 wells. If oil storage tanks are manually gauged and sampled, one employee can service approximately 25 tanks. If automatic gauging and sampling devices have been installed, one person can service the equivalent of 100 to 150 tanks. In a large, modern field, one five-man maintenance crew can service up to 50 wells. If the field contains many small, non-utilized leaseholds, more people will be needed to control production and maintain facilities.

(OG SIM Serial No.) _____ (Serial Number) _____

OIL AND GAS LEASE STIPULATIONS

(% of lease affected by stipulation)

(___) No occupancy or other activity on the surface of the following-described land is allowed under this lease: (___)

This limitation may be modified when specifically approved in writing by the District Engineer, Geological Survey (GS), with concurrence of the District Manager, Bureau of Land Management(BLM).

(___) No occupancy or other surface disturbance will be allowed within _____ feet of the _____. This distance may be modified when specifically approved in writing by the District Engineer, Geological Survey (GS), with the concurrence of the District Manager, Bureau of Land Management (BLM). (___)

(___) No drilling or storage facilities will be allowed within _____ feet of _____ located in _____. This distance may be modified when specifically approved in writing by the District Engineer, Geological Survey (GS), with the concurrence of the District Manager, Bureau of Land Management (BLM). (___)

(___) No occupancy or other surface disturbance will be allowed on slopes in excess of _____ percent, without written permission from the District Engineer, Geological Survey (GS), with the concurrence of the District Manager, Bureau of Land Management (BLM). (___)

(___) In order to _____, exploration, drilling, and other development activity will be allowed only during the period from _____ to _____. Lands within the leased area to which this stipulation applies are described as follows: (___)

Exceptions to this limitation in any year may be specifically authorized in writing by the District Engineer, Geological Survey (GS), with the concurrence of the District Manager, Bureau of Land Management (BLM).

(___) The _____ will not be used as an access road for activities on this lease. This limitation may be modified when specifically approved in writing by the District Engineer, Geological Survey (GS), with concurrence of the District Manager, Bureau of Land Management (BLM). (___)

_____ _____

Date Lessee's Signature

_____
(Serial Number)

OIL AND GAS LEASE STIPULATIONS

CULTURAL RESOURCES - Prior to undertaking any surface disturbing activities on the lands covered by this lease, the lessee or operator shall, unless notified to the contrary by the District Manager, Bureau of Land Management:

A. Engage the services of a qualified cultural resource specialist to conduct an intensive cultural resource inventory of the areas to be impacted for evidence of cultural resource values.

B. Submit an acceptable report to the authorized officer of the surface management agency and the District Engineer of the U. S. Geological Survey.

C. Take such measures as deemed necessary to preserve or avoid destruction of cultural resource values. Mitigation may include relocation of proposed facilities, testing and salvage or other protective measures deemed necessary by the authorized officer. All costs of the survey and salvage of cultural resource values will be borne by the lessee or operator and all data and materials salvaged will remain under the jurisdiction of the U. S. Government as appropriate.

Should significant paleontological values be encountered in areas of the proposed action, prior to surface disturbance, the information will be forwarded to the District Manager, Bureau of Land Management for evaluation and appropriate action to follow.

The lessee or operator shall immediately bring to the attention of the District Engineer, U. S. Geological Survey, any antiquities or other objects of scientific interest discovered as a result of operations under this lease and shall leave such discoveries intact until directed to proceed by the District Engineer, U. S. Geological Survey.

ESTHETICS - To maintain esthetic values, all semi-permanent facilities may require painting or camouflage to blend with the natural surroundings. The paint selection or method of camouflage will be subject to approval by the District Engineer, Geological Survey (GS), with the concurrence of the District Manager, Bureau of Land Management (BLM).

EROSION CONTROL - In order to minimize watershed damage, during muddy and/or wet periods, the District Manager, Bureau of Land Management (BLM), through the District Engineer, Geological Survey (GS), may prohibit exploration, drilling or other development. This limitation does not apply to maintenance and operation of producing wells.

_____ _____
Date Lessee's Signature

_____ _____
(OG Sim Serial Number) (Serial Number)

OIL AND GAS LEASE STIPULATIONS

(% of lease affected by stipulation)

(____) In order to _____, (____) exploration, drilling and other development activity and maintenance and operation of producing wells and facilities that requires on site access will be allowed only during the period from _____ to _____. Lands within the lease area to which this stipulation applies are described as follows:

Exceptions to this limitation in any year may be specifically authorized in writing by the District Engineer, Geological Survey (GS), with the concurrence of the District Manager, Bureau of Land Management (BLM).

_____ _____
Date Lessee's Signature

(OG Sim Serial Number) _____ (Serial Number) _____

OIL AND GAS LEASE STIPULATIONS

(% of lease affected by stipulation)

(____) In order to minimize watershed damage and protect fragile soils, surface disturbing activities will be allowed only during the period from _____ to _____. Lands within the leased area to which this stipulation applies are described as follows: (____)

Exceptions to this limitation in any year may be specifically authorized in writing by the District Engineer, Geological Survey (GS), with the concurrence of the District Manager, Bureau of Land Management (BLM).

_____ _____

Date Lessee's Signature

(OG Sim Serial Number) _____ (Serial Number) _____

OIL AND GAS LEASE
WILDERNESS PROTECTION STIPULATION

(% of lease affected)

(____) By accepting this lease, the lessee acknowledges that the lands contained in this lease which are identified below are being inventoried or evaluated for their wilderness potential by the Bureau of Land Management under section 603 of the Federal Land Policy and Management Act of 1976, 90 Stat. 2743, 2785 (43 U.S.C. Sec. 1782). (____)

/__/ All lands within the lease
/__/ Part of the lands within the lease described as follows:

Until the BLM determines that the lands described above do not meet the criteria for a wilderness study area as set forth in section 603, or until Congress decides against the designation of lands included within this lease as "wilderness," the following conditions apply to this lease, and override every other provision of this lease which could be considered as inconsistent with them and which deal with operations and rights of the lessee:

1. Any oil or gas activity conducted on the leasehold for which a surface use plan is not required under NTL-6 (for example: geophysical and seismic operations) may be conducted only after the lessee first secures the consent of the BLM. Such consent shall be given if BLM determines that the impact caused by the activity will not impair the area's wilderness characteristics.

2. Any oil and gas exploratory or development activity conducted on the leasehold which is included within a surface use plan under NTL-6 is subject to regulation (which may include no occupancy of the surface) or, if necessary, disapproval until the final determination is made by Congress to either designate the area as wilderness or remove the section 603 restrictions.

If all or any part of the area included within the leasehold estate is formally designated by Congress as wilderness, oil and gas exploration and development operations taking place or to take place on that part of the lease shall become subject to the provisions of the Wilderness Act of 1964 which apply to national forest wilderness areas, 16 U.S.C. Sec. 1131 et. seq., as amended, the Act of Congress designating the land as wilderness, and Interior Department regulations and policies pertaining thereto. If it is found that the area does not have wilderness characteristics or is not suitable to be designated a part of the National Wilderness Preservation system, development and/or surface occupancy will be subject to the remaining lease terms and the special stipulatons.

_____ _____

Date Lessee's Signature

APPENDIX 2-2

MONTANA BUREAU OF LAND MANAGEMENT POLICY WITH REGARD TO THE NATIONAL HISTORIC PRESERVATION ACT

Compliance with the 36 CFR 800 Regulations is done according to the following Bureau of Land Management policy in Montana, North Dakota, and South Dakota.

Application

These regultions apply to all federal undertakings which might affect a cultural property. The definition of federal undertaking is very broad and includes all actions, activities, or programs, or any type of assistance, support, or sanction of non-federal undertakings. The procedures shall be applied in time to be included in the preparation of Environmental Analysis Reports or Environmental Statements in order to provide sufficient lead time for the consultation explained below. In any case, these procedures shall be completed prior to BLM final approval or action on an undertaking.

Identification of Cultural Properties

For Bureau initiated actions, all cultural properties which would be impacted must be identified. For general land use decisions (e.g., an oil and gas lease offering), at a minimum known properties from the district Class I inventory and the current listing of National Register and eligible properties must be consulted before the decision is formally made. Before specific ground disturbing actions under these land use decisions are authorized (e.g., Application for Permit to Drill), a Class III inventory must be completed over the area of impact. For all other Bureau-initiated ground disturbing actions, whether covered by a general land use decision or not, a Class III inventory must be completed over the area of impact before authorization. For non-Bureau initiated actions, the same general provisions apply, but the applicant may be required to fund and contract actual field work.

Evaluation of Cultural Properties

Once all cultural properties within the impact zone are identified, they must have the criteria for eligibility in the National Register applied to them. After the criteria are applied to all cultural sites, these determinations (with documentation) must be sent to the SHPO as part of the consultation process described below.

Consultation for Identification and Evaluation Phases

The SHPO should be consulted as early during decision planning as possible. Consultation must be done on large scale projects or land use decisions by writing the SHPO at the planning stage to request inventory information. The SHPO should supply a list of all previously inventoried cultural properties, evaluation of the quality of those inventories, and recommendations for further inventory needs, methods, and boundaries. The SHPO's recommendations should be given serious consideration before the inventory is done.

For all ground disturbing actions, a Class III inventory will be done for the area of impact. The inventory report will be part of the consultation document. It should be adequate to define impact area and inventory methods, and to evaluate sites for National Register eligibility. The inventory report with the site forms should be sent to the SHPO with the BLM's opinion on eligibility and effect (if Register eligible properties are present). If no properties are found or properties are found and avoided, SHPO comment must be obtained before project authorization can be given.

If BLM and SHPO agree that no site meets the criteria for eligibility, this must be documented and the undertaking can proceed without further SHPO, National Register, or Advisory Council review. If BLM and SHPO agree on the eligibility determination for all sites, documentation showing that both agree must be developed. This documentation must be sent to the Secretary of the Interior for his formal eligibility determination.

If the BLM and SHPO disagree on eligibility, a request for determination of eligibility can be made directly to the Secretary of Interior through the National Register. It is probable that the Secretary will request further information, and substantial time

delays in project clearance would result. If it is thought that the BLM and SHPO will disagree, more complete documentation on the BLM's opinion should be prepared in order to aid the Secretary's decision.

Determination of Effect on Cultural Properties

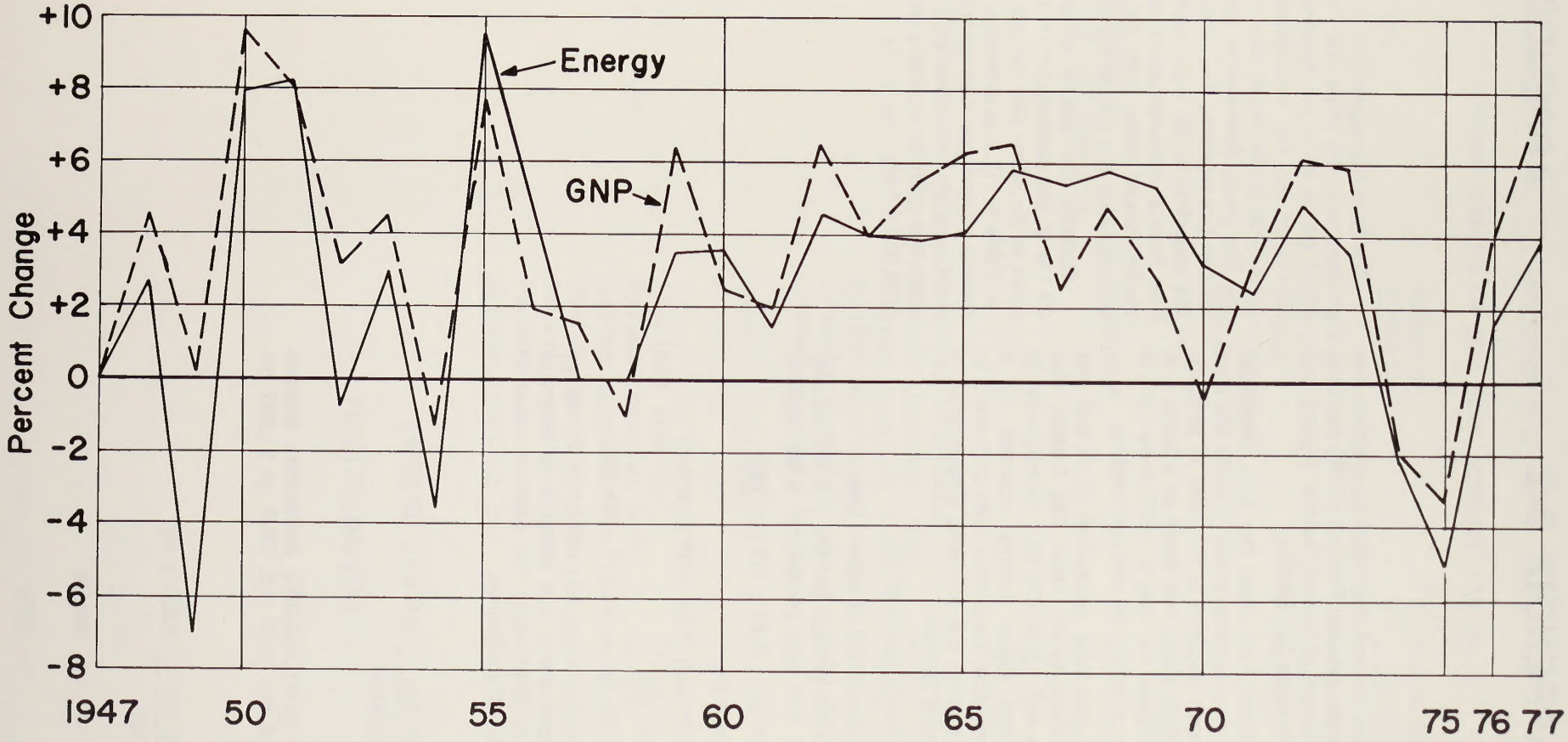
For all properties on or eligible for the National Register, a determination of the effect of the project on the property must be made in consultation with the SHPO. If BLM determines that there will be no effect, it must notify the SHPO of that decision. If SHPO objects, the Advisory Council will be given opportunity to comment. Effect is defined as the condition when the undertaking will make any change in integrity of location, design, setting, materials, workmanship, feeling, or association that contributes to the significance of the National Register or eligible property.

If BLM determines that an effect will occur, the criteria for determining adverse effect must be applied to the properties, again in consultation with the SHPO. This can be done concurrently with the initial determination of effect, by documenting those effects predicted to occur to the property. The determination may result in a no adverse effect decision or an adverse effect decision. A no adverse effect determination must be documented and sent to the SHPO with a data recovery plan (if applicable) for his written opinion. An adverse effect determination must be documented through preparation of a preliminary case report, and also sent to the SHPO for his written opinion. Adverse effects are those effects which: (1) destroy or alter the property, (2) isolate from or alter the property's surroundings, (3) introduce visual, audible, or atmospheric elements out of character with the property, (4) neglect the property to the point of deterioration or destruction, or (5) allow the property to pass from federal ownership without protecting stipulations.

When effect has been documented, this documentation, along with SHPO's written opinion, must be sent to the Advisory Council for comment. A no adverse effect determination would allow the undertaking to proceed under the conditions of the no adverse effect documentation. An adverse effect determination will usually require a Memorandum of Agreement, written by the Advisory Council, with signatories including the BLM, Advisory Council, SHPO, and in the case of non-Bureau initiated actions, the Applicant. In most cases the major portion of the Memorandum of Agreement will consist of the Preliminary Case Report developed by BLM staff.

APPENDIX
FIGURE 3–1

U. S. ENERGY CONSUMPTION AND G.N.P., 1947–1977



Source: U.S. Dept. of the Interior, Bureau of Mines, and U.S. Statistical Abstract, 1977.

APPENDIX 3-2

The following method was used to estimate the loss in U.S. Gross National Product (GNP) resulting from the curtailment of leasing federal oil and gas resources in the Miles City District.

Recent national data from the U.S. Statistical Abstract show that approximately 73,000 Btu's of energy have been required in the past to produce one dollar of GNP. Using this figure as a base, it is possible to estimate the loss in GNP likely from a discontinuation of federal oil and gas leasing.

In FY 1978, the total production of oil and gas from federal leases in the Miles City District was 5,101,709 bbls and 1,659,739 mcf, respectively. In order to convert these energy volumes to a common denominator, they were both converted to Btu equivalents using the following Department of Energy conversion factors:

5.61 million Btu's/barrel of oil

1.02 million Btu's/mcf of natural gas

Using these conversion factors, the Btu equivalent of the oil and gas production is as follows:

Oil: $(5.102 \times 10^6 \text{ bbls})\ (5.61 \times 10^6 \text{ Btu/bbl})$

$= 28.62 \times 10^{12}$ Btu

Gas: $(1.660 \times 10^6 \text{ mcf})\ (1.02 \times 10^6 \text{ Btu/mcf})$

$= 1.69 \times 10^{12}$ Btu

Total: 30.31×10^{12} Btu $= 30{,}310 \times 10^9$ Btu

Based upon this expected reduction in energy (oil and gas) availability, it is possible to estimate the reduction in GNP using the national value of 73,000 Btu's/$GNP as follows:

$$\frac{30{,}310 \times 10^9 \text{ Btu}}{73 \times 10^3 \text{ Btu/\$GNP}} = \$415.2 \times 10^6 \text{ (GNP)}$$

$$= \$415{,}200{,}000 \text{ (GNP)}$$

This figure ($415,200,000) represents approximately .02% of the 1977 U.S. GNP of $1,887 billion:

$$\frac{\$\ 415.2 \times 10^6}{\$1{,}887 \times 10^9} = .2200 \times 10^3$$

$$= .00022$$

$$= .02\%$$

APPENDIX 3-3

The total Btu equivalent from federal oil and gas production in the Miles City District in FY 1978 was 30.31 trillion Btu's (re: Appendix 3-2). This figure is 23.1% of the Btu equivalent for all oil and gas production in the Miles City District. Assuming that the Btu production/worker ratio is similar for both oil and gas workers, it is reasonable to expect that the reduction in Btu equivalent oil and gas production from a discontinuation of federal oil and gas leasing would affect both oil and gas employment opportunities in a similar manner.

Applying the federal oil and gas proportion of 23.1% to the estimated total direct oil/gas employment in the Miles City District (i.e., 633 employees, re: Table 4-11), it is estimated that the cessation of federal oil and gas leasing could result in a loss of approximately 146 direct jobs (.231 x 633) and the attendant direct annual payroll of $2,628,000 ($18,000 x 146).

APPENDIX 4-1

CURRENT STATUS OF SCS SOIL SURVEYS (1979)

Soil Survey Status	Montana Counties	South Dakota Counties
Published	Treasure	Meade (southern)
	Powder River	Butte
	Wibaux	Bennett
	Dawson	Mellette
	Big Horn	Shannon
		Todd
		Washabaugh
Field mapping completed Not published, but information available	Richland	Laurence
		Stanley
		Dewey
		Tripp
		Perkins
Field mapping not completed Advance material available for surveyed portion of area	Rosebud (southern)	Harding
	McCone (partial 95%)	Meade (northern)
	Carter (partial 10%)	Jones
	Fallon (partial 10%)	Gregory
	Prairie (partial 10%)	Fall River
	Custer (partial 10%)	
Reconnaissance (BLM, SCS) Survey	Garfield (partial)	
No data available (General Soils Map only)	Garfield (partial)	Jackson
	Fallon (partial 90%)	Custer
	Carter (partial 90%)	Haakon
	Custer (partial 90%)	Ziebach
	Prairie (partial 90%)	Carson
	Rosebud (northern)	Pennington
	McCone (partial 5%)	Lyman

APPENDIX 4-2
MAMMALS IN THE STUDY AREA

SPECIES	PREFERRED HABITAT
Sorex merriami Merriam's shrew	Arid areas - sage
Sorex preblei Preble's shrew	Marshes
Sorex cinereus Common shrew	Forests - brushland
Lasiurus cinereus Hoary bat	Wooded areas
Lasionycteris noctivagans Siver-haired bat	Forests - buildings
Plecotus townsendii Western big-eared bat	Caves - buildings
Eptesicus fuscus Big brown bat	Caves, hollow trees, buildings
Myotis erotis Long-eared bat	Thinly forested areas - buildings
Myotis keeni Keen's myotis	Mines, caves
Myotis thysanodes Fringed bat	Caves, buildings
Myotis volans Long-legged bat	Buildings, crevices
Myotis leibii Masked bat	Caves, crevices, buildings; in or near forest areas
Myotis yumanensis Yuma bat	Caves, buildings, arid areas
Myotis lucifugus Little brown bat	Caves, trees, buildings
Lepus townsendii White-tailed jackrabbit	Grassy areas, sagebrush
Lepus californious Black-tailed jackrabbit	Open prairies
Sylvilagus audubonii Desert cottontail	Open plains
Sylvilagus nuttalli Mountain cottontail	Thickets, sagebrush
Sylvilagus floridanus Eastern cottontail	Heavy brush
Erithizon dorsatum Porcupine	Forested areas
Castor canadensis Beaver	Streams and lakes
Thomomys talpoides Northern pocket gopher	Grassy prairies
Dipoclomys ordii Ord's kangaroo rat	Chaparral covered slopes
Perognathus fasciatus Wyoming pocket mouse	Short-grass prairie
Marmota flaviventris Yellow-bellied marmot	Rocky areas
Eutamias minimus Least chipmunk	Mixed hardwood forests
Citellus lateralis Golden-mantled ground squirrel	Mountain areas
Cynomys ludovicianus Black-tailed prairie dog	Dry upland prairies
Cynomys leucurus White-tailed prairie dog	Open country
Citellus tridencemlineatus 13-lined ground squirrel	Short-grass prairie
Citellus richardsonii Richardson's ground squirrel	Sagebrush, grasslands
Tamiasciurus hudsonicus Red squirrel	Pine areas
Zapus princeps Western jumping mouse	Near streams
Zapus hudsonius Meadow jumping mouse	Low meadows
Sciurus miger Eastern fox squirrel	Open hardwoods
Neotoma cinerea Bushy-tailed wood rat	Rimrocks, pines

Reithrodontomys megalotis Western harvest mouse	Grasslands
Onychomys leucogaster Northern grasshopper mouse	Prairies
Peromyscus maniculatus Deer mouse	Most habitats
Peromyscus leucopus White-footed deer mouse	Wooded areas
Ondatra zibethicus Muskrat	Marshes, ponds
Lagurus curtatus Sagebrush vole	Sagebrush
Clethrionomys gapperi Red-backed vole	Damp forests
Microtus ochrogastor Prairie vole	Open prairies
Microtus longicandus Long-tailed vole	Stream banks
Microtus pennsylvanicus Meadow vole	Low, moist areas
Felis concolor Mountain lion	Rugged mountains, forests
Lynx canadensis Lynx	Forests
Lynx rufus Bobcat	Rimrocks
Procyon lotor Raccoon	Streams, lakes
Vulpes vulpes Red fox	Forests - open
Vulpes velox Swift fox	Deserts, plains
Canis lantrans Coyote	Prairies
Lutra canadensis River otter	Streams, lakes
Taxidea taxus Badger	Grasslands
Mephitis mephitis Striped skunk	Semi-open country
Spilogale gracilis Western spotted skunk	Wooded, brushy areas
Mustela vison Mink	Streams, lakes
Mustela nigripes Black-footed ferret	Prairies
Mustela nivalis Least weasel	Meadows, fields
Mustela frenata Long-tailed weasel	Not restricted
Mustela erminea Ermine	Brushy or wooded areas
Antilocapra americana Pronghorn	Open prairies, sage-brush
Cervus canadensis Elk	Semi-open forests
Odocolieus virginianus White-tailed deer	Forests, brushy areas
Odocoileus hemionus Mule deer	Forest-prairies, woodlands
Ovis canadensis Bighorn sheep	Sloping, rugged terrain

Source: Burt, W.H. and R.P. Grossenheider 1976. Field Guide to Mammals (3rd Edition). Houghton Mifflin Co., Boston. 289 pp.

APPENDIX 4-2

BIRDS IN THE STUDY AREA

SPECIES	PREFERRED HABITAT
Gavia immer Common loon	Lakes-rivers
Aechmophorus occidentalis Western grebe	Lake vegetation
Podiceps auritus Horned grebe	Lake vegetation
P. caspicus Eared grebe	Shallow lakes
Podilymbus podiceps Pied-billed grebe	Shallow fresh water
Phalocrocorax auritus Double-crested cormorant	Lakes-rivers
Branta canadensis Canadian goose	Lake shores
Chen hyperborea Snow goose	Lake shores
Anas platyrhynchos Mallard	Ponds-marshes
A. acuta Pintail	Lakes-ponds
A. strepera - Gadwall	Ponds and marshes
Mereca americana American widgeon	Ponds and marshes
Spatula clypeata Shoveler	Ponds and marshes
A. discors Blue-winged teal	Ponds and marshes
A. cyanoptera Cinnamon teal	Ponds and marshes
A. carolinensis Green-winged teal	Ponds and marshes
Aix sponsa Wood duck	Woodland lakes
Aythya americana Redhead	Deeper lakes
A. valisineria Canvasback	Deeper lakes
A. collaris Ring-necked duck	Deeper lakes
A. marila Greater scaup	Deeper lakes
A. affinis Lesser scaup	Deeper lakes
Bucephala clangula Common goldeneye	Forested lakes and rivers
B. albeola Bufflehead	Wooded lakes and rivers
Oxyura jamaicensis Ruddy duck	Lakes-ponds
Mergus merganser Common merganser	Lakes-rivers
M. serrator Red-breasted merganser	Lakes-rivers
Lophodytes cucullatus Hooded merganser	Wooded lakes and rivers
Cathartes aura Turkey vulture	Open fields
Accipiter gentilis Goshawk	Northern forests
A. cooperii Cooper's hawk	Open woodlands
A. striatus Sharp-shinned hawk	Open woodlands
Circus cyaneus Marsh hawk	Grasslands and marshes
Buteo lagopus Rough-legged hawk	Open country
B. regalis Ferruginous hawk	Plains
B. jamaicensis Red-tailed hawk	Plains
B. swainsoni Swainson's hawk	Plains
Aguila chrysaetos Golden eagle	Plains-mountains
Haliaeetus leucocephalus Bald eagle	Along shores
Pandion haliaetus Osprey	Along shores
Falco mexicanus Prairie falcon	Plains
F. peregrinus Peregrine falcon	Cliffs-plains
F. columbarius Pigeon hawk	Open areas
F. sparverius Sparrow hawk	Open areas
Meleagris gallopavo Turkey	Pine forests
Pedioecetes phasianellus Sharp-tailed grouse	Grasslands
Centrocercus urophasianus Sage grouse	Sagebrush

Tympanuchus cupido Greater prairie chicken	Grasslands
Phasianus colchicus Ring-necked pheasant	Farmland
Perdix perdix Hungarian partridge	Wheatlands
Leocophoyx thula Snowy egret	Marshes
Pelecanus erythrorhynchos White pelican	Lakes
Ardea herodias Great blue heron	Lakes
Nycticorax nycticorax Black-crowned night heron	Marshes
Botaurus lentiginosus American bittern	Marshes
Grus americana Whooping crane	Marshes-fields
G. canadensis Sandhill crane	Marshes-fields
Rallus limicola Virginia rail	Marshes
Porzana carolina Sora	Marshes
Coturnicops noveboracensis Yellow rail	Marshes
Fulica americana American coot	Marshes-lakes
Eupoda montana Mountain plover	Plains
Pluvialis dominica American golden plover	Fields-pastures
Squatarola squatarola Black-bellied plover	Fields-pastures
Charadrius melodus Piping plover	Sandy beaches
C. semipalmatus Semipalmated plover	Beaches-mudflats
C. vociferus Killdeer	Fields-pastures
Limosa fedoa Marbled godwit	Prairies-meadows
L. haemastica Hudsonian godwit	Marshes-meadows
Bartramia longicauda Upland plover	Grass
Tyrngites subruficollis Buff-breasted sandpiper	Short grass
Tringa solitaria Solitary sandpiper	Lake shores
Actitis macularia Spotted sandpiper	Lakes-marshes
Catoptrophorus semipalmatus Willet	Lakes
Totanus melanoleucus Greater yellowlegs	Lakes-marshes
T. flavipes Lesser yellowlegs	Lakes-marshes
Micropalama himantopus Stilt sandpiper	Marshes-mudflats
Limnodromus griseus Short-billed dowitcher	Lake shores
L. scolopaceus Long-billed dowitcher	Lake shores
Erolia melanotos Pectoral sandpiper	Marshes-fields
Crocethia alba Sanderling	Sandy beaches
Erolia fuscicollis White-rumped sandpiper	Lake shores
E. bairdii Baird's sandpiper	Short-grassy marshes
E. minutilla Least sandpiper	Marshes-mudflats
Ereunetes pusillus Semipalmated sandpiper	Lake shores
E. mauri Western sandpiper	Mudflats
Steganopus tricolor Wilson's phalorope	Prairie sloughs
Lobipes lobatus Northern phalorope	Lakes
Capella gallinago Common snipe	Marshes-bogs
Larus argentatus Herring gull	Lakes
L. delawarensis Ring-billed gull	Lakes
L. pipixcan Franklins gull	Lakes
L. philadelphia Bonapartes gull	Lakes
Sterna hirundo Common tern	Lakes
S. forsteri Foresters tern	Lakes-marshes
Hydroprogne caspia Caspian tern	Lakes
Chlidonias niger Black tern	Lakes-marshes
Columba livia Pigeon	Farmyards-parks
Zenaidura macroura Mourning dove	Farmland

Coccyzus americanus Yellow-billed cuckoo	Woods-brush
C. erythropthalmus Black-billed cuckoo	Woods-brush
Otus asio Screech owl	Woodlots
Bubo virginianus Great horned owl	Woodlands
Asio otus - Long-eared owl	Deciduous forests
A. flammeus Short-eared owl	Open country
Tyto alba Barn owl	Farmyards-fields
Strix varia Barred owl	Woodlands
Speotyto cunicularia Burrowing owl	Prairie dog towns
Aegolius funereus Boreal owl	Coniferous forests
Aegolius acadicus Saw-whet owl	Evergreens-thickets
Phalaenoptilus nuttallii Poor-will	Woodlands
Chordeiles minor Common nighthawk	Woodlands-parks
Chaetura pelagica Chimney swift	
Archilochus colubris Ruby-throated hummingbird	Gardens-woods
Megaceryle alcyon Belted kingfisher	Streams-rivers
Colaptes auratus Flicker	Open woodlands
Dryocopus pileatus Pileated woodpecker	Deciduous forest
Melanerpes erythrocephalus Red-headed woodpecker	Deciduous forest
Sphyrapicus varius Yellow-bellied sapsucker	Deciduous forest
Dendrocopos villosus Hairy woodpecker	Deciduous woods
D. pubescens Downy woodpecker	Deciduous woods
Tyrannus tyrannus Eastern kingbird	Open country
T. verticalis Western kingbird	Plains
Sayornis phoebe Eastern phoebe	Farmyards
S. saya Say's phoebe	Plains
Empidonax flaviventris Yellow-bellied flycatcher	Spruce-fir forests
E. traillii Traills flycatcher	Swamps-bogs
E. minimus Least flycatcher	Wood margins
Contopus virens Eastern wood pewee	Deciduous woods
C. sordidulus Western wood pewee	Deciduous woods
Nuttallornis borealis Olive-sided flycatcher	Coniferous forests
Eremophila alpestris Horned lark	Large fields
Hirundo rustica Barn swallow	Farmyards
Petrochelidon pyrrhonota Cliff swallow	Cliffs
Iridoprocne bicolor Tree swallow	Trees near water
Riparia riparia Bank swallow	River banks
Stelgidopteryx ruficollis Rough-winged swallow	Near water
Progne subis Purple martin	Where nest boxes are provided
Pica pica Black-billed magpie	Open woodlands
Corvus brachyrhynchos Common crow	Farmland
Parus atricapillus Black-capped chickadee	Woodlands
Sitta carolinensis White-breasted nuthatch	Deciduous woods
S. canadensis Red-breasted nuthatch	Coniferous woods
Certhia familiaris Brown creeper	Woodlands
Troglodytes aedon House wren	Brush
Salpinctes obsoletus Rock wren	Rocky barrens
Telmatodytes palustris Long-billed marsh wren	Swampy bogs
Mimus polyglottos Mockingbird	Brush
Dumetella carolinensis Catbird	Dense cover
Toxostoma rufum Brown thrasher	Brush

Turdus migratorius Robin	Open woodlands
Myadestes townsendi Townsend's solitaire	Woodlands
Hylocichla guttata Hermit thrush	Woodlands
H. ustulata Swainson's thrush	Woodlands
H. minima Grey-cheeked thrush	Woodlands
H. fuscescens Veery	Woodlands
Sialia sialis Eastern bluebird	Open woodlands
Sialia currucoides Mountain bluebird	Open woodlands
Regulus satrapa Golden-crowned kinglet	Coniferous forests
R. calendula Ruby-crowned kinglet	Coniferous forests
Anthus spinoletta Water pipit	Muddy shores
A. spragueii Sprague's pipit	Grassy shores
Bombycilla garrula Bohemian waxwing	Woodlands
B. cedrorum Cedar waxwing	Woodlands
Lanius excubitor Northern shrike	Open woodlands
L. ludovicianus Loggerhead shrike	Open woodlands
Sturnus vulgaris Starling	Parks-farms
Vireo solitarius Solitary vireo	Mixed hardwood-coniferous
V. olivaceus Red-eyed vireo	Deciduous forests
V. gilvus Warbling vireo	Deciduous forests
Mniotilta varia Black and white warbler	Deciduous woods
Vermivora peregrina Tennessee warbler	Aspen and spruce woods
V. celata Orange-crowned warbler	Low trees, shrubs
V. ruficapilla Nashville warbler	Deciduous woods
Dendroica petechia Yellow warbler	Willow thickets
D. magnolia Magnolia warbler	Hemlock-spruce forests
D. coronata Myrtle warbler	Spruce-fir forests
D. audubonii Audubon's warbler	Coniferous forests
D. virens Black-throated green warbler	Coniferous forests
D. striata Blackpoll warbler	Coniferous forests
Seiurus aurocapillus Ovenbird	Deciduous woods
S. noveboracensis Northern waterthrush	Northern bogs
Geothlypis trichas Yellowthroat	Moist shrubs
Icteria virens Yellow-breasted chat	Deciduous thickets
Oporornis tolmiei MacGillivray's warbler	Dense thickets
O. philadelphia Mourning warbler	Heavy underbrush
Wilsonia pusilla Wilson's warbler	Willow thickets
Setophaga ruticilla American redstart	Deciduous understory
Passer domesticus House sparrow	Farms-cities
Dolichonyx oryzivorus Bobolink	Hayfields
Sturnella magna Eastern meadowlark	Prairies
S. neglecta Western meadowlark	Prairies
Xanthocephalus xanthocephalus Yellow-headed blackbird	Marshes
Agelaius phoeniceus Red-winged blackbird	Marshes
Euphagus carolinus Rusty blackbird	Wooded swamps
E. cyanocephalus Brewer's blackbird	Farms, fields
Quiscalus quiscula Common grackle	Farmlands
Molothrus ater Brown-headed cowbird	Farmlands

Icterus spurius Orchard oriole	Orchards-woody margins
I. galbula Northern oriole	Deciduous forests
Piranga ludoviciana Western tanager	Coniferous forests
Pheucticus melanocephalus Black-headed grosbeak	Open woodlands
Hesperiphona vespertina Evening grosbeak	Conifers
Passerina cyanea Indigo bunting	Wood margins
P. amoena Lazuli bunting	Deciduous growth
Carpodacus purpureus Purple finch	Woodlands
Pinicola enucleator Pine grosbeak	Spruce and fir forests
Leucosticte tephrocotis Gray-crowned rosy finch	
Acanthis flammea Common redpoll	Weedy fields
Spinus pinus Pine siskin	Conifers
S. tristis American goldfinch	Bushes
Loxia curvirostra Red crossbill	Pine woods
Spiza americana Dickcissel	Grainfields
Pipilo erythrophthalmus Rufous-sided towhee	Brushy undergrowth
Passerculus sandwichensis Savannah sparrow	Short-grass fields
Ammondramus savannarum Grasshopper sparrow	Hayfields
A. bairdii Baird's sparrow	
Passerherbulus candacutus Le Conte's sparrow	Marsh grass
Ammospiza caudacuta Sharp-tailed sparrow	Marsh grass
Calamospiza melanocorys Lark bunting	Prairie
Pooecetes gramineus Vesper sparrow	Meadows-hay-grain fields
Chondestes grammacus Lark sparrow	Dry fields
Junco aikeni White-winged junco	Yellow pine forest
J. hyemalis Slate-colored junco	Brushy clearings
Spizella arborea Tree sparrow	Willow thickets
S. passerina Chipping sparrow	Sparse grass
S. pallida Clay-colored sparrow	Open brushland
S. breweri Brewer's sparrow	Sage
S. pusilla Field sparrow	Abandoned fields
Zonotrichia querula Harris sparrow	Wood margins
Z. leucophrys White-crowned sparrow	Wood margins-thickets
Z. albicollis White-throated sparrow	Dense undergrowth
Passerella iliaca Fox sparrow	Dense thickets
Melospiza lincolnii Lincoln's sparrow	Thickets
M. georgiana Swamp sparrow	Marshes
M. melodia Song sparrow	Bushes-woody margins
Rhynchophanes mccownii McCowan's longspur	Arid plains
Calcarius ornatus Chestnut-collared longspur	Plains-prairies
C. lapponicus Lapland longspur	Prairies
C. pictus Smith's longspur	Short grass plains
Plectrophenax nivalis Snow bunting	Short grass prairie

SOURCE: Robbins et al., 1966

APPENDIX 4-2

FISHES IN THE STUDY AREA

SPECIES	PREFERRED HABITAT
Lepomis cyanellus Green sunfish	Small creeks to large rivers and farm ponds to large reservoirs. Most favorable are backwaters of streams
Lepomis macrochirus Bluegill	Lakes and ponds with abundant vegetation
Micropetrus dolomieni Smallmouth bass	Streams with extensive riffles. In lakes, found near reefs or outcrops. Intermediate temperatures
Micropterus salmoides Largemouth bass	Lakes, ponds, and reservoirs
Pomoxis annularis White crappie	Streams, lakes, and reservoirs with broad tolerance to turbidity
Pomoxis nigromaculatus Black crappie	Large clear streams, lakes, and reservoirs
Perca flavescens Yellow perch	Cool, clear lakes or slow-moving streams with abundant vegetation
Ambloplites rupestris Rock bass	Moderately warm, clear, rocky streams
Lepomis gibbosus Pumpkinseed	Warm, clear water
Stizostedion canadense Sauger	Large turbid rivers and their impoundments
Stizostedion vitreum Walleye	Reservoirs, lakes, and rivers
Rhinichthys cataractae Longnose dace	Broad tolerance for water temperature and turbidity conditions
Carpoides carpio River carpsucker	Pools and backwaters of streams and reservoirs with a broad turbidity tolerance
Moxostoma macrolepidotum Shorthead redhorse	Clear or turbid waters of larger rivers and creeks where temperatures are intermediate and the current is swift

Catosomus catostomus Longnose sucker	Most abundant in clear, cold streams and lakes, but also found in streams with moderate temperatures and high turbidities
Catostomus commersoni White sucker	Widely distributed in lakes, streams, and rivers. Has broad temperature and turbidity tolerance
Catostomus platyrhynchus Mountain sucker	Clear, cool streams with clean rubble, gravel, or sand bottoms. Tolerates a wide range of turbidities
Ictalurus melas Black bullhead	Shallow lakes, ponds, and backwaters of streams. Has broad temperature and turbidity tolerance
Ictalurus punctatus Channel catfish	Large rivers and low-land lakes
Noturus flavus Stonecat	Has a broad temperature and turbidity tolerance
Lota lota Burbot	Cold water species found in larger
Esox lucius Northern pike	Lakes, reservoirs, and marshes. Common in backwaters of large streams where vegetation is present
Cyprinus carpio Carp	Moderately warm, shallow rivers and lakes where aquatic vegetation is plentiful
Notemigonus crysoleucas Golden shiner	Clear sluggish streams, ponds, and lakes with abundant aquatic vegetation
Hybopsis gracilis Flathead chub	Plains streams with high turbidity
Hybopsis gelida Sturgeon chub	Turbid water over gravel areas with moderate to strong current

Couesins plumbens Lake chub	Creek type habitat at lower elevations
Notropis atherinoides Emerald shiner	Larger streams and impoundments with little aquatic vegetation
Notropis stramineus Sand shiner	Large and small streams with clear water, rapid current, and sand or gravel bottoms
Hybognathus hankinsoni Brassy minnow	Prefers clear, slow streams with sandy bottoms but has been found in larger rivers with high turbidities
Hybognathus placitus Plains minnow	Large streams
Hybognathus nuchalis Silvery minnow	Large streams
Pimephales promelas Fathead minnow	Small turbid creeks and shallow ponds of the flatlands
Scaphirhynchus albus Pallio sturgeon	Large turbid rivers and their impoundments
Scaphirhynchus platorynchus Shovelnose sturgeon	Large rivers with sandy bottoms and strong current
Polyodon spathula Paddlefish	Large turbid streams and/or rivers and their impoundments
Hiodon alosoides Goldeye	Large rivers and lakes with a tolerance to high turbidity
Salmo gairdneri Rainbow trout	Lakes, reservoirs, and farm ponds; adapts to a wide range of temperature conditions
Etheostoma exile Iowa darter	Lakes and streams
Aplodinotus grunniens Freshwater drum	Deep ponds in reservoirs and large streams
Salvelinus fontinalis Brook trout	Small spring fed, gravel bottom streams
Ictiobus bubalus Smallmouth buffalo	Variable
Phoxiuus eos Northern redbelly dace	Slow flowing small creeks
Phoxinus neogaeus Finescale dace	Small clear streams
Cycleptus elongatus Blue sucker	Deer water of large rivers and reservoirs
Culaea inconstans Brook stickleback	Small, clear, cold streams

Esox lucius Northern pike	Bays of lakes and reservoirs and marshes and backwater
Carassius auratus Goldfish	Warm, low turbid, no-current ponds
Semotilus margarita Pearl dace	Small cool streams
Semotilus atromaculatus Creek chub	Creek habitat
Lepisosteus platostomus Shortnosed gar	Large rivers, backwaters, and impoundments
Ictalurus natalis Yellow bullhead	Clear-flowing, rocky-bottomed streams

APPENDIX 4-2

AMPHIBIANS AND REPTILES OF THE STUDY AREA

SPECIES	PREFERRED HABITAT
AMPHIBIANS	
Sacphiopus bombifrons Plains spadefoot	Loose, sandy, and gravely soil areas on short grass prairies
Bufo cognatus Great Plains toad	Floodplains of streams and rivers on the short grass prairie
Bufo w. woodhousei Rocky Mountain toad	Short grass prairie bordering the larger rivers and their tributaries
Pseudacris tri. maculata Boreal chorus frog	Lakes, ponds, pools, and swampy areas
Rana pipens Leopard frog	Ponds, rivers, lakes, springs, creeks, and temporary pools. They will feed far from water in damp meadows
Ambystoma tigrinum Tiger salamander	Farm ponds, pools, lakes, reservoirs, potholes, in dry creek beds
REPTILES	
Phrynosoma douglassi brevirostre Eastern short-horned lizard	Fine loose soil areas in a variety of upland habitat types
Chrysemys picta Painted turtle	Lakes, ponds, rivers, and streams
Chelydra serpentina Snapping turtle	Streams, rivers, lakes, and ponds, with soft banks or bottoms for hibernation and hiding
Trionyx spiniferus hartwegi Western spiny softshell	Rivers, streams, ponds, lakes, and ditches; preferring waters with bottoms of gravel, sand, silt, or mud
Crotalus viridis Prairie rattlesnake	Rocky hillsides, bluffs and outcroppings

Pituphis melanoleucus sayi Bull snake	Prairie grassland
Heterodon n. nasicus Plains hog-nose snake	Gravely or sandy soil areas covered with grass or low shrubs and dry stream bottoms
Coluber constrictor flaviventris Eastern yellow-bellied racer	Open areas associated with both moist and dry prairie conditions
Thamnophis sirtalis Common garter snake	Ponds and streams, marshes and damp meadows
Thamnophis radix Plains garter snake	Prairie ponds, agricultural areas, and farm buildings

APPENDIX 4-3

CONFIRMED WHOOPING CRANE SIGHTINGS IN MONTANA

DATE	LOCATION	NUMBER OF BIRDS
	Medicine Lake National Wildlife Refuge	
October 14, 1958		1
May 4, 1960		4
October 25, 1961		4
Spring 1962 (Flying over Refuge)		2
April 30, 1963		1
September 26, 1965 (Flying over just west of Refuge)		3
October 18 & 19, 1967		3
October 29, 1967		3
April, 1972 (Flying over Refuge)		8
October 29, 1975		4
October 30 - November 6, 1975		3
	Lamesteer National Wildlife Refuge	
May 4-8, 1968		4
Spring 1975		6
	Other Confirmed Sightings	
April 30, 1963	25 miles of Medicine Lake NWR (Harmon Ranch)	2
April 30, 1963	25 miles SE of Medicine Lake NWR (Harmon Ranch)	8
May 3, 1963	1 mile from NE corner of Medicine Lake NWR	2
October 15-18, 1965	20 miles SE of Medicine Lake NWR	3
November 12, 1967	Just off Medicine Lake NWR, 1 mile NE Headquarters	1
April 8, 1969	NE Medicine Lake NWR on area now WPA	6
April, 1972	1 mile from Medicine Lake NWR boundary, near Holmstead	2
April 13-14, 1974	Custer County, T1N, R54E, Section 8	2
April 3, 1979	T13N, R60E, Section 13	2

SOURCE: US Fish and Wildlife Service 1979 (unpublished information).

APPENDIX 4-4

RATIONALE FOR ESTIMATING REGIONAL PROPORTIONS OF THE MONTANA ANTELOPE POPULATION

On the basis of permits allocated from 1973 to 1977, Montana Department of Fish and Game, Region 7, appears to support the bulk of the state antelope population.

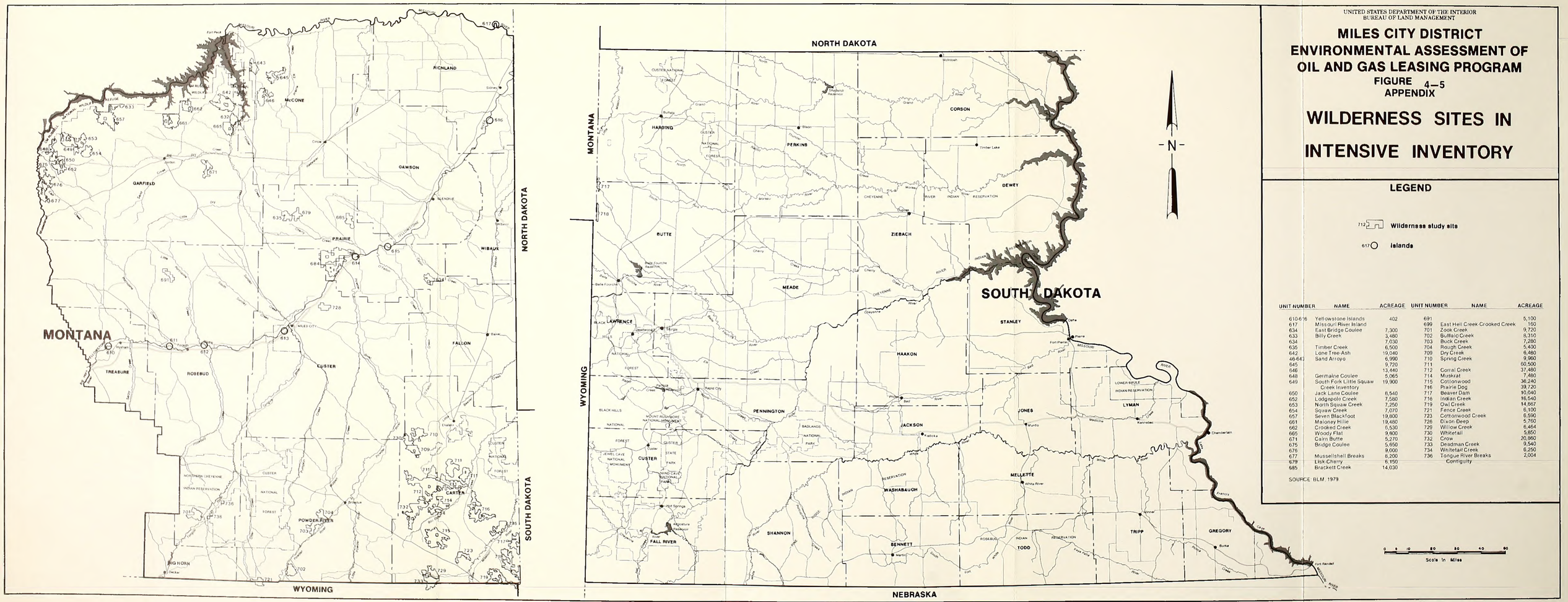
Preliminary Allocations of Antelope Permits in Montana

	Region				
Year	3	4	5	6	7
1973	2,360	5,300	5,925	4,500	12,325
1974	2,210	4,975	7,300	3,950	13,170
1975	1,945	3,700	8,300	3,240	12,720
1976	1,450	3,900	8,775	2,940	11,530
1977	1,635	3,910	8,275	3,020	10,590
Avg.	1,920	4,357	7,695	3,530	12,067
Percent	6.5	14.7	26.0	12.0	40.8

Realizing that permit allocations are affected by access to public land and private land closures as well as antelope numbers, the above table does provide an indirect indication of antelope populations by Department of Fish and Game records.

SOURCE: BLM, 1979

☆ GPO 1980-697-682



UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

MILES CITY DISTRICT ENVIRONMENTAL ASSESSMENT OF OIL AND GAS LEASING PROGRAM

FIGURE 4—5
APPENDIX

WILDERNESS SITES IN INTENSIVE INVENTORY

LEGEND

712 Wilderness study site

617 Islands

UNIT NUMBER	NAME	ACREAGE	UNIT NUMBER	NAME	ACREAGE
610-616	Yellowstone Islands	402	691		5,100
617	Missouri River Island		699	East Hell Creek-Crooked Creek	160
634	East Bridge Coulee	7,300	701	Zook Creek	9,720
633	Billy Creek	3,480	702	Buffalo Creek	8,310
634		7,030	703	Buck Creek	7,280
635	Timber Creek	6,500	704	Rough Creek	5,400
642	Lone Tree-Ash	19,040	709	Dry Creek	6,480
46-643	Sand Arroyo	6,990	710	Spring Creek	9,960
645		9,720	711		60,500
646		13,440	712	Corral Creek	37,480
648	Germaine Coulee	5,065	714	Muskrat	7,480
649	South Fork Little Squaw Creek Inventory	19,900	715	Cottonwood	36,240
			716	Prairie Dog	39,720
650	Jack Lane Coulee	8,540	717	Beaver Dam	10,040
652	Lodgepole Creek	7,580	718	Indian Creek	16,540
653	North Squaw Creek	7,250	719	Owl Creek	14,867
654	Squaw Creek	7,070	721	Fence Creek	6,100
657	Seven Blackfoot	19,800	723	Cottonwood Creek	6,590
661	Maloney Hills	19,480	726	Dixon Deep	5,760
662	Crooked Creek	6,530	729	Willow Creek	6,464
665	Woody Flat	9,800	730	Whitetail	5,850
671	Cairn Butte	5,270	732	Crow	20,960
675	Bridge Coulee	5,650	733	Deadman Creek	9,540
676		9,000	734	Whitetail Creek	6,250
677	Musselshell Breaks	8,200	736	Tongue River Breaks Contiguity	2,004
679	Lisk-Cherry	6,150			
685	Brackett Creek	14,030			

SOURCE: BLM 1979

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